MONTHLY WEATHER REVIEW.

Editor: Prof. CLEVELAND ABBE.

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INTRODUCTION.

The MONTHLY WEATHER REVIEW for December, 1903, is based on data from about 3300 stations, classified as follows:

Weather Bureau stations, regular, telegraph and mail, 166; West Indian Service, cable and mail, 15; River and Flood Service, 52, river and rainfall, 177, rainfall only, 62; voluntary observers, domestic and foreign, 2565; total Weather Bureau Service, 2962; Canadian Meteorological Service, by telegraph and mail, 20, by mail only, 13; Meteorological Service of the Azores, by cable, 2; Meteorological Office, London, by cable, 8; Mexican Telegraph Company, by cable, 3; Army Post Hospital reports, 18; United States Life-Saving Service, 9; Southern Pacific Company, 96; Hawaiian Meteorological Service, 75; Jamaica Weather Service, 130; Costa Rican Meteorological Service, 25; The New Panama Canal Company, 5; Central Meteorological Observatory of Mexico, 20 station summaries, also printed daily bulletins and charts, based on simultaneous observations at about 40 stations; Mexican Federal Telegraph Service, printed daily charts, based on about 30 stations.

Special acknowledgment is made of the hearty cooperation of Prof. R. F. Stupart, Director of the Meteorological Service of the Dominion of Canada; Mr. Curtis J. Lyons, Territorial Meteorologist, and Mr. R. C. Lydecker, Acting Territorial Meteorologist, Honolulu, H. I.; Señor Manuel E. Pastrana, Director of the Central Meteorological and Magnetic Observatory of Mexico; Camilo A. Gonzales, Director-General of Mexican Telegraphs; Capt. S. I. Kimball, Superintendent of the United States Life-Saving Service; Lieut. Commander W. H. H. Southerland, Hydrographer, United States Navy; H. Pittier, Director of the Physico-Geographic Institute, San José, Costa Rica; Commandant Francisco S. Chaves, Director of the Meteorological Service of the Azores, Ponta Delgada, St. Michaels, Azores; W. N. Shaw, Esq., Secretary, Meteorological Office, London; Rev. José Algué, S. J., Director, Philippine Weather Service; and H. H. Cousins, Chemist, in charge of the Jamaica Weather Office; Señor Enrique A. Del Monte, Director of the Meteorological Service of the Republic of Cuba.

Attention is called to the fact that the clocks and self-registers at regular Weather Bureau stations are all set to seventy-fifth meridian or eastern standard time, which is exactly five hours behind Greenwich time; as far as practicable, only this standard of time is used in the text of the REVIEW, since all Weather Bureau observations are required to be taken and recorded by it. The standards used by the public in the United States and Canada and by the voluntary observers are believed to conform generally to the modern international system of standard meridians, one hour apart, beginning with Greenwich. The Hawaiian standard meridian is 157° 30′, or $10^h\ 30^m$ west of Greenwich. The Costa Rican standard of time is that of San José, $0^h\ 36^m\ 13^s$ slower than seventy-fifth meridian time, corresponding to $5^h\ 36^m$ west of Greenwich. Records of miscellaneous phenomena that are reported occasionally in other standards of time by voluntary observers or newspaper correspondents are sometimes corrected to agree with the eastern standard; otherwise, the local standard is mentioned.

Barometric pressures, whether "station pressures" or "sea-level pressures," are now reduced to standard gravity, so that they express pressure in a standard system of absolute measures.

FORECASTS AND WARNINGS.

By Prof. E. B. GARRIOTT, in charge of Forecast Division.

During the first and second decades of the month prevailing low barometric pressure over the British Isles was attended by a succession of severe gales over the eastern Atlantic. During a greater part of the third decade there was a reversal of the usual barometric pressures over western Europe, the barometer being high over northwestern and low over southwestern European countries. This abnormal distribution of pressure produced unusually low temperatures over central and southwestern Europe. During the period of low pressure over the British Isles the barometer continued relatively high in the vicinity of the Azores, and several depressions that crossed the eastern part of the United States with a moderate show of energy increased in intensity as they advanced over the Atlantic in high latitudes.

In the United States the storms of the first two decades of December lacked seasonal intensity, a fact that may, perhaps, be attributed to the peculiar barometric conditions, referred to, that existed to the eastward. During the third decade, however, two storms of marked severity advanced from the westward across the New England coast. The principal storms of the month on the Great Lakes occurred on the 12th and 19–20th. The storms of the Gulf of Mexico and Pacific coast were not attended by gales of marked severity.

Ample and timely warning was given United States ports of the high winds of the month.

The first cold wave of December appeared over the British Northwest Territory on the 11th; extended over the central valleys on the 12th, carrying the line of zero temperature to southern Illinois and southern Indiana; covered the Ohio Valley and the Lake region on the 13th, with freezing temperature in the interior of the west Gulf States, and extended over the interior of New England during the 14th. A cold wave that appeared over Manitoba on the 24th extended southward and southeastward carrying the line of zero temperature nearly to the Ohio River by the morning of the 26th, and reached the middle and east Gulf and Atlantic coasts on the morning of the 27th, with freezing temperature as far south as Tampa, Fla. During the 29th and 30th a cold wave advanced from the eastern part of the British Northwest Territory over the Ohio Valley and the Lake region.

Frequent frosts were reported on the middle and east Gulf coasts, in central and northern Florida, and parts of California. Killing frost occurred at Mobile, Ala., on the 3d, at New Orleans, La., and Pensacola, Fla., on the 27th, and at Red Bluff, Cal., on the 7th. Heavy frost occurred as far south as Tampa, Fla., on the 4th, 7th, 22d, 28th, and 30th, at San Francisco, Cal., on the 9th, at Los Angeles, Cal., on the 22d, and at Fresno, Cal., on the 8th, 10th, 15th, 18th, 26th, 28th, and 30th.

Timely warnings were issued to all interests affected by cold waves and frosts.

The Sugar Planters' Journal, New Orleans, La., January 2, 1904, remarks editorially, in part, as follows, regarding the frost warnings issued to sugar planters in Louisiana:

During the late sugar campaign we were again given an example of the inestimable value the local Weather Bureau is to the sugar planters of this State, which class of agriculturalists are more benefited than any other through the warnings issued by the Bureau in question.

BOSTON FORECAST DISTRICT.

The storm of the 20th–21st was severe, and the gales and heavy seas that attended it caused shipping to seek harbors of safety. The storm of the 26–27th was also severe, especially along the southern coast, where shipping was imperiled and several lives were lost. Timely warnings of the gales resulted in much benefit to shipping and other interests.—*J. W. Smith, District Forecaster.*

NEW ORLEANS FORECAST DISTRICT.

No severe gales occurred. Warnings were issued on the 12th for a general cold wave over the greater part of the district, and the warnings were fully justified. Ample warning was also given of other frosts and freezing temperatures that occurred in the sugar and trucking districts during the month.—*I. M. Cline, District Forecaster.*

CHICAGO FORECAST DISTRICT.

As a rule warnings were issued far in advance of the cold waves of the 11th to 13th, 21st–22d, 25–26th, and 29–30th, and advices were issued in advance of the snowstorms of the 12th, 25th, and 28th. Timely and ample warning was given shipping interests of the high winds and gales of the month. The month was unusually free from lake disasters, and it is probable that the storm warnings were, in many cases, a great benefit.—*H. J. Cox, Professor and District Forecaster.*

DENVER FORECAST DISTRICT.

No severe storms or cold waves occurred, and the month was generally mild and dry.—*F. H. Brandenburg, District Forecaster.*

SAN FRANCISCO FORECAST DISTRICT.

On the 7th a disturbance over lower California resulted in nearly one-third of an inch of rain at San Diego. With this exception the month was one of prolonged fair weather.—*A. G. McAdie, Professor and District Forecaster.*

PORTLAND, OREG., FORECAST DISTRICT.

The month was unusually quiet on the north Pacific coast, the only storms of consequence occurring on the 1st, 14th, 15th, and 19th. In each instance storm warnings were displayed well in advance of the storms. No severe cold weather occurred.—*A. B. Wollaber, Acting District Forecaster.*

RIVERS AND FLOODS.

At the end of December the Mississippi River was frozen from the headwaters to a short distance below the mouth of the Des Moines River. It remained open, however, during the first half of the month, except in the vicinity of Leclaire, Iowa, where it was closed during the entire month. From Hannibal to Cairo there was much heavy floating ice, and navigation between St. Louis and Cairo was suspended on the 9th. No ice was reported below Cairo.

The Missouri River was closed as far south as Sioux City, Iowa, and by the 7th of the month it had closed practically to Omaha. It did not close below, although floating ice was observed almost daily.

There were large quantities of ice in the Ohio River and its tributaries, necessitating the suspension of navigation at various points, particularly above Cincinnati. Many gorges were reported between Wheeling and Cincinnati, but they passed away without unusual incident.

The rivers of New England, except the Housatonic and the extreme southern Connecticut, were generally closed, except where kept open by artificial means. The Hudson River from Albany northward and the Mohawk River were frozen solid, and at the end of the month there were 10 inches of ice at Albany and the ice harvest was in progress.

The upper Susquehanna at Wilkesbarre closed on the 16th for the first time during the present season, and at Harrisburg on the 17th. The ice moved out five days later, but on the 28th the river at Wilkesbarre was again frozen over. At Lockhaven, Pa., the west branch of the Susquehanna was frozen during the entire month, and at Williamsport from the 15th to the 21st. The Juniata River was also icebound during the greater portion of the month.

There was considerable ice in the Potomac River and its tributaries, and by the end of the month the Shenandoah and upper Potomac were practically closed. A little ice was observed on the 18th and 19th in the upper Roanoke River, and this was about the southern limit of ice for the month.

In all the rivers the stages of water were about normal for the season and afforded no features of special interest.

The highest and lowest water, mean stage, and monthly range at 194 river stations are given in Table VII. Hydrographs for typical points on seven principal rivers are shown on Chart V. The stations selected for charting are Keokuk, St. Louis, Memphis, Vicksburg, and New Orleans, on the Mississippi; Cincinnati and Cairo, on the Ohio; Nashville, on the Cumberland; Johnsonville, on the Tennessee; Kansas City, on the Missouri; Little Rock on the Arkansas; and Shreveport, on the Red.—*H. C. Frankenfield, District Forecaster.*

AREAS OF HIGH AND LOW PRESSURE.

Movements of centers of areas of high and low pressure.

Number.	First observed.			Last observed.			Path.		Average velocity.	
	Date.	Lat. N.	Long. W.	Date.	Lat. N.	Long. W.	Length.	Duration.	Daily.	Hourly.
High areas.		°	°		°	°	*Miles.*	*Days.*	*Miles.*	*Miles.*
I	2, p. m.	48	122	5, p. m. 8, a. m.	43 38	108 80	950 3,800	3.0 5.5	317 691	13.2 28.8
II	10, a. m.	28	97	13, a. m.	46	60	2,600	3.0	867	36.1
III	13, p. m.	50	107	16, a. m.	38	87	1,750	2.5	700	29.2
IV	15, a. m.	53	105	19, p. m.	42	70	2,200	4.5	489	20.4
V	18, a. m.	37	122	21, p. m.	28	83	2,850	3.5	814	33.9
VI	21, a. m.	53	105	23, p. m.	35	75	2,300	2.5	920	38.3
VII	25, a. m.	53	108	28, a. m.	27	80	2,700	3.0	900	37.5
VIII	27, a. m.	51	104	29. p. m.	46	60	2,900	2.5	1,160	48.3
IX	28, p. m.	53	105	*1. a. m.	30	82	2,550	3.5	728	30.0
Sums							24,600	33.5	7,586	316.0
Mean of 10 paths							2,460		758	31.6
Mean of 33.5 days									734	30.6
Low areas.										
I	1, a. m.	54	114	5, a. m.	48	68	2,650	4.5	589	24.5
II	5. p. m.	51	114	8, a. m.	45	64	2,550	2.5	1,020	42.5
III	7, p. m.	32	100	10, p. m.	48	68	2,425	3.0	808	33.7
IV	8, a. m.	53	105	9, p. m.	42	87	1,150	1.5	767	32.0
V	10, p. m.	47	112	13, p. m.	46	60	3,100	3.0	1,033	43.0
VI	17, a. m.	39	120	21, a. m.	47	65	3,250 3,625	4.0	812 906	33.8 37.8
VII	19, p. m.	50	120	23, a. m.	48	53	3,175	3.5	907	37.8
VIII	24, a. m. 24, p. m.	54 28	114 97	26, p. m.	46	60	3,050 2,500	2.5 2.0	1,220 1,250	50.8 52.1
IX	25, p. m.	54	114	28, a. m.	46	60	2,625	2.5	1,050	43.8
Sums							30,100	29.0	10,362	431.8
Mean of 11 paths							2,736		942	39.3
Mean of 29.0 days									1,038	43.2

*January.

For graphic presentation of the movements of these highs and lows see Charts I and II.—*George E. Hunt, Chief Clerk, Forecast Division.*

CLIMATE AND CROP SERVICE.

By Mr. JAMES BERRY, Chief of Climate and Crop Service Divison.

The following summaries relating to the general weather and crop conditions during December are furnished by the directors of the respective sections of the Climate and Crop Service of the Weather Bureau; they are based upon voluntary reports from meteorological observers and crop correspondents, of whom there are about 3000 and 14,000, respectively:

Alabama.—Cold, dry month, with much freezing weather. Rainfall generally deficient, except slightly above normal in a few southwestern counties. Less than average acreage in wheat and oats, but more oats will be sown in January and February if conditions should be favorable; some November sown wheat and oats killed by cold, which much retarded germination of recent seeding. Comparatively little preparation for next season's crops. Rain on 25th beneficial. Fruit trees in good condition.—*F. P. Chaffee.*

Arizona.—Droughty conditions continued, though light rain and snow fell during the first half of the month. Early seeded winter grain was generally doing well, but much of that seeded late had not germinated on account of the drought. Range feed quite abundant, but stock water scarce; stock generally in good condition; no severe weather to cause stock to suffer.—*M. E. Blystone.*

Arkansas.—The first of the month was unusually cold, but the latter part was about seasonal. Continued dry weather prevented the usual amount of plowing. Small grain made little progress. Cotton picking progressed as the weather permitted, but at the close of the month some little remained in the fields. Fruit buds were uninjured. Stock was generally thrifty.—*Edward B. Richards.*

California.—The mean temperature for the State was slightly above normal, but extremely low temperatures occurred during the month in nearly all sections, and severe frosts were frequent. In the central and northern sections the rainfall was ample and crops made good growth, but in the south, where very little rain fell during the season, crops were backward, pasturage was scarce, and cattle were suffering, while the water supply was rapidly failing. Frosts caused trifling damage.—*Alexander G. McAdie.*

Colorado.—The mild weather was unusually favorable to live stock, but ranges were poor in parts of the Arkansas and Rio Grande valleys, and generally over the eastern foothill districts, and stock water was low on the slopes of the Divide, in the southeastern counties, and in areas on the western slope. The dryness was unfavorable to fall sown grain, much of which remained dormant. A fair flow of water was reported from the South Platte and Arkansas.—*F. H. Brandenburg.*

Florida.—The abnormally cold and very dry conditions seriously retarded most plant growth. Seed germinated slowly and considerable damage resulted to tender vegetables from frost during the first and last decades. Moderate shipments of celery and lettuce were made, but tomatoes, beans, and Irish potatoes were short. Citrus fruits were improved by cold weather. Pineapple growth was retarded very much. Plowing was advanced, and a good acreage was planted to oats.—*A. J. Mitchell.*

Georgia.—The deficiency in temperature was very marked, the mean being the lowest on record for December for the State at large. The weather was steadily cold throughout the month. The precipitation was below the normal in all sections, the greatest departure occurring in the northern section and the least in the southern. Germination and growth of wheat and oats were retarded by the cold weather, and oats were damaged in many sections.—*J. B. Marbury.*

Idaho.—Temperature about normal. Precipitation somewhat deficient. Weather clear during the first decade; cloudy from the 11th to the 22d, with some rain and snow, and generally bright and pleasant afterwards. The condition of winter range was generally above average during the month, with very little snow on the ground in valleys and low plains; stock did well, with less feeding than usual.—*S. M. Blandford.*

Illinois.—The condition of wheat was very uneven. In the northern district it was protected by snow; in the central district it was injured by alternate freezing and thawing, and by insufficient covering; reports indicate that the injury was confined to the tops; in the southern district growth was retarded on account of lack of moisture, and the plant was small and in poor condition to withstand severe cold. Much corn was soft and chaffy. Rye was in fair condition. Pastures had failed in the southern district. Apples and potatoes were not generally keeping well.—*William G. Burns.*

Indiana.—In the northern and the greater portion of the central sections wheat was in fair condition, although small; in the southern section it was not only small on account of having been sown late, but owing to the droughty conditions which prevailed during and following seeding, the stand was poor; considering the State, as a whole, the wheat crop was in only fairly good condition. Good progress was made in gathering corn.—*W. T. Blythe.*

Iowa.—December was extremely dry with less than usual amount of stormy weather. Though the temperature was slightly below normal the month was very favorable for farm operations usual to the season, and for promoting health and growth of stock. The fields yielded good forage for the grazing herds. Fall wheat and rye suffered somewhat from bare fields and low temperatures, but the area of these crops was small.—*John R. Sage.*

Kansas.—The weather was favorable for field work, except on the 23d, 24th, and 25th. Some plowing done in the central, eastern, and southern counties. Much corn was gathered. Wheat in most of the State was in fair condition (much of it in good condition), and in the southeastern counties was being pastured. Early wheat was damaged by fly in a few central counties, but late wheat was in good condition. Cattle were in good condition.—*T. B. Jennings.*

Kentucky.—Cold, dry weather prevailed during the month, the temperature being almost continuously below normal. There was not enough snow to afford much protection. Wheat and oats were in an unsatisfactory condition at the beginning of winter, and the unfavorable weather during December still further lowered the chances for a good crop. The steady cold was quite favorable to fruit trees. Stock was in fairly good condition.—*H. B. Hersey.*

Louisiana.—General rains fell in all parts of the State during the month and the long drought was brought to an end. Preparations for spring crops were pushed forward as rapidly as possible. A small acreage was seeded to oats. Sugar harvest was completed except on a few large plantations, where grinding will continue well into January. The tonnage of cane per acre was much below the average, but the yield of sugar per ton was very satisfactory. Seed cane was successfully protected during the freezes and was in good condition. Some cane was planted during the month. Truck gardens and the berry crop showed effects of the severe drought. The orange crop was good.—*I. M. Cline.*

Maryland and Delaware.—Unusually hard freezing, the absence of snow, and the prevalence of high winds rendered December weather very damaging to wheat and grasses, particularly the late sown; except in the extreme west, where snow protection was afforded, the condition of wheat was very unpromising. No pasturage of consequence; early feeding necessary; stock in good condition. Very little plowing possible. Roads excellent for the winter operations of hauling fuel and produce. Ice houses filled.—*Oliver L. Fassig.*

Michigan.—Winter wheat and rye were generally well covered and protected by snow during the entire month. There was very little, if any, alternate freezing and thawing of the ground, and correspondents, with but very few exceptions, agree that no damage was done to winter grain. When wheat and rye went under the snow they were in a healthy and promising condition, although the plants were rather small.—*C. F. Schneider.*

Minnesota.—There were cold periods from the 12th to the 16th, and from the 25th to the 30th, and at no time during the month was there a minimum above 32°. The snow on the ground ranged from 2 or 3 inches in the southern part of the State to much greater depths in the timbered regions of the north; in the prairie regions the sleighing was not very good. Ice cutting began in the southern portions about the 28th, the ice being from 15 to 20 inches thick. No farming operations, except corn husking and the care of stock, were possible.—*T. S. Outram.*

Mississippi.—The month was unusually cold, with much freezing weather. The rainfall was generally light over the middle portion of the State, but nearly normal over the northern and southern portions. Cotton picking was completed and some plowing was done, but generally very little farm work was accomplished. A small acreage of wheat and oats was doing fairly well. Strawberries were in poor condition.—*W. S. Belden.*

Missouri.—In most sections of the State the month was cold and dry. Winter wheat received little protection from snow, and in many counties, especially in the central and southern sections, suffered from lack of moisture. The condition of the crop at the close of the month was, however, very near the average, except in portions of the central and southern sections, where in some counties it was very unpromising. The month was very favorable for gathering standing corn and that work was practically completed.—*A. E. Hackett.*

Montana.—The temperature was above normal, except during a moderately cold period from the 11th to the 14th. The precipitation was very generally deficient. Snows were fairly frequent about the middle of the month, but they were light. There was not enough snow in the eastern counties to give the soil the usual amount of winter moisture. Stock were wintering well.—*Montrose W. Hayes.*

Nebraska.—The unusually dry weather of the month was rather unfavorable for winter wheat, but probably no material damage resulted, as there was no unseasonably cold weather and no severe wind. The month was very favorable for farm work, and corn husking was about completed. All work on the farm was in unusually satisfactory condition for the winter.—*G. A. Loveland.*

Nevada.—The temperature was nearly normal, but the precipitation was remarkably light in all sections. Range feed was fairly good in most sections, and stock did well. The snowfall in the mountains was

much lighter than usual, and unevenly distributed over the several ranges. A fine crop of thick, clear ice was harvested the latter part of the month.—*J. H. Smith.*

New England.—The month was much colder than usual, the mean temperature being the lowest in the history of the New England Climate and Crop service, except in 1890, when it was 21.1°. The maximum temperature of the district was 57°, the lowest of record for December. The precipitation was deficient, except in Rhode Island and Connecticut, and the deficiency was severely felt in Vermont and New Hampshire, where springs and wells were low. The weather was favorable to ice harvesting, but unfavorable to the lumber interests.—*J. W. Smith.*

New Jersey.—The prevailing weather conditions were unfavorable to the late sown grain, especially wheat; almost continuous freezing temperature prevented growth and in some places germination; early sown wheat, rye, and grass were in fair condition; no injury from thawing.—*Edward W. McGann.*

New Mexico.—Drought continued. Grass was short on the stock ranges, and water very scarce, even for domestic purposes. Cattle and sheep, with but few exceptions, were reported to be in very good condition for the season.—*R. M. Hardinge.*

New York.—The month was unusualy cold and the ground was frozen, but was generally covered with snow. Snow flurries were frequent, and there was very little thawing. Wheat and rye were in good condition and well protected by snow. On account of the early winter and continued cold weather, plowing was not finished and some corn was not saved. Some apples were also lost.—*R. G. Allen.*

North Carolina.—The month was characterized by continuously cold and rather dry weather. The mean temperature for the State was the lowest for the month since 1876, and the precipitation the least since 1872 with the single exception of December, 1889. On account of the dryness and the large average number of clear days the weather was not unpleasant, though unfavorable for the best growth of winter wheat and oats. The absence of snow covering, lack of sufficient moisture, and frozen condition of the ground prevented rapid growth, so that all the winter crops were very backward. Most of the wheat was not up; that which was up looked fairly well. Streams were very low, especially in the west. Some forest fires occurred in the lower portion of the Blue Ridge Mountains.—*C. F. von Herrmann.*

North Dakota.—There was considerable snow on the ground during the month, but it was drifted to such an extent that a large part of the ranges was bare, and as a rule stock was able to feed during the month.—*B. H. Bronson.*

Ohio.—The weather was not favorable for corn husking. Grass and winter grains were generally well protected by snow, except in extreme southern and southwestern districts; the snowfall was less in those districts than in other sections of the State. Early sown wheat was in fairly good condition in most sections; that sown late got a very poor start and the outlook was very poor in all central and southern counties.—*J. Warren Smith.*

Oklahoma and Indian Territories.—Moderate rains and even temperatures were beneficial to crops in the ground; droughty conditions were intensified in the western division, where the greater portion of wheat remained unsprouted; wheat generally made a slow growth and was small but in good condition; the Hessian fly caused damage in Kay County and Cherokee Nation; wheat seeding was nearing completion. Cotton picking was completed with short to fair yields. Corn husking was about completed; plowing for spring crops progressed. Stock did well.—*C. M. Strong.*

Oregon.—December was everywhere cooler and drier than usual and considerable foggy weather prevailed. On account of the cool weather germination was slow, and both early sown grain and forage plants made but little advance. Early sown fall wheat and oats started nicely and the plants were healthy and vigorous. Stock was in much better condition than at the same time last year, and less feeding was done. Pastures, as a rule, were still green and fruit trees were in good condition.—*Edward A. Beals.*

Pennsylvania.—The month, as a whole, was the coldest in seventeen years. The average precipitation was less than one-half the amount which fell during the corresponding period last year. Except in the southeastern and south-central counties, winter grains and grasses were amply protected. In districts not so favored the soil was necessarily exposed to continued high winds, and the fields looked thin and bare, but it is not thought that the roots were injured to any great extent—*T. F. Townsend.*

Porto Rico.—Heavy rains delayed the maturing of cane and interrupted sugar making in some of the northern and eastern districts. Dry weather prevailed throughout the southern division and grinding continued without interruption until the holidays. The yield so far obtained was good. Cane not yet arrowed made fair progress. Coffee picking was finished; the crop was generally larger than in 1902 and of good quality. Transplanted tobacco did well and considerable seed was sown in the central districts. The continued showers caused cotton in the boll to become spotted. Some rice, corn, sweet potatoes, and mafafos were harvested, and as far as practicable land was prepared for spring planting—*E. C. Thompson.*

South Carolina.—The month was unusually cold, with much alternate freezing and thawing in the interior sections that was harmful to grain sown on moist lands. The prevailing clear weather favored heavy frost deposits, but these frosts did little damage, as practically all vegetation had been killed in November, except truck along the coast, that made a precarious growth. The precipitation was generally deficient. The snowfall was too light and melted too quickly to afford any protection to winter grain. Oats made no growth and looked poor. Wheat sowing made some progress, but germination was unsatisfactory. Very little winter fallowing was done.—*J. W. Bauer.*

South Dakota.—The bulk of the monthly snowfall occurred prior to the 13th, after which much fair weather prevailed. Cold period from 8th to 16th. Winter rye and the limited amount of winter wheat sown continued in satisfactory condition, being protected by snow during the cold period, and favored by absence of alternate freezing and thawing. In the east portion of State snow on ground necessitated a larger consumption of hay than usual; conditions on stock ranges in west portion generally favorable. But little corn in field on 31st.—*S. W. Glenn.*

Tennessee.—The month was generally cold and dry, and the outlook for winter grain at the close was the worst for many years, owing to frozen ground and surface thawing. Much of the crop was sown late in dry soil, so that it was slow in coming up and made little growth. There was not sufficient snow during the month to afford much protection, precipitation in general being slightly below the normal.—*H. C. Bate.*

Texas.—The moderate temperature conditions of the month were favorable for crops. However, the drought which prevailed was very unfavorable, especially in the western portion. West of the ninety-eighth meridian wheat, rye, barley, and fall sown oats suffered greatly and east of that meridian growth was greatly retarded. The harvesting of sugar cane was completed with satisfactory results. In the northern portion, the small amount of cotton which remained in the fields was practically all picked and in some localities the dry unopened bolls were picked and thrashed. Feed on the ranges was becoming very short, but as a result of the pleasant weather stock was generally in good condition.—*L. H. Murdoch.*

Utah.—The temperatures throughout the section were generally below the normal. Precipitation was decidedly below the average, being the least recorded for the section during a record of thirteen years, and the outlook for irrigation water was unfavorable throughout the southern portion, where there had been a decided shortage in rainfall for the last three months. Winter grain was generally in good condition and well protected in northern counties by a good covering of snow. Owing to the long continued drought in the southern part of the section, ranges were poor and stock were not in thriving condition.—*R. J. Hyatt.*

Virginia.—Temperatures persistently lower than the normal and a decided deficiency in precipitation combined to make crop progress slow. In the absence of snow in many portions of the State, the ground became hard frozen, and there was much winter killing of wheat, oats, and clover, especially the late seeded. In trucking districts kale and spinach, the main winter crops, suffered serious injury, and in many cases were an entire failure. Winter plowing was at a standstill during the month.—*Edward A. Evans.*

Washington.—The comparatively dry weather and mild temperature were favorable for seasonable farm work, the growth of wheat, and the health and thriftiness of fruit trees. In the wheat belt there were 3 to 6 inches of snow during the second decade, which nearly all melted by the end of the month. The fall wheat grew well and had a fine stand.—*G. N. Salisbury.*

West Virginia.—Dry, cold weather prevailed during the month, and winter wheat, rye, and oats, which did not have much protection from snow over a great portion of the State, were damaged considerably, and at the close of the month they were in very poor condition. Practically no farm work was done, as the weather was too cold and the ground frozen too hard. Stock was reported in good order and feed plentiful.—*E. C. Vose.*

Wisconsin.—The month was extremely cold throughout, but the snow which fell in November remained on the ground and, with the additional snowfall during the month, afforded ample protection to the winter grains and grasses generally. In a few localities, however, where the high winds caused much drifting, the fields were exposed in places and some damage is believed to have resulted. The dry weather during the month interfered with the preparation of tobacco for market, and most of the crop was still in the sheds. Stock was generally reported as wintering in good condition.—*W. M. Wilson.*

Wyoming.—The month was unusually pleasant throughout the State, and no damaging storm occurred over any section. Stock continued in excellent condition, and practically no losses occurred. The limited snowfall in the mountains caused some apprehension of a scarcity of water for late summer irrigation during the coming season.—*W. S. Palmer.*

In the following table are given, for the various sections of the Climate and Crop Service of the Weather Bureau, the average temperature and rainfall, the stations reporting the highest and lowest temperatures with dates of occurrence, the stations reporting greatest and least monthly precipitation, and other data, as indicated by the several headings.

The mean temperatures for each section, the highest and lowest temperatures, the average precipitation, and the greatest and least monthly amounts are found by using all trustworthy records available.

The mean departures from normal temperature and precipitation are based only on records from stations that have ten or more years of observation. Of course the number of such records is smaller than the total number of stations.

Summary of temperature and precipitation by sections, December, 1903.

Section.	Temperature—in degrees Fahrenheit.							Precipitation—in inches and hundredths.					
	Section average.	Departure from the normal.	Monthly extremes.					Section average.	Departure from the normal.	Greatest monthly.		Least monthly.	
			Station.	Highest.	Date.	Station.	Lowest.	Date.			Station.	Amount.	Station.	Amount.
Alabama	40.9	−5.8	Daphne	71	24	Hamilton	11	27	2.93	−1.44	Citronelle	5.28	Anniston	0.69
Arizona	45.7	−0.2	Dragoon	84	3	Fort Defiance	−2	6	0.12	−0.90	Pinal Ranch	0.86	14 stations	0.00
Arkansas	39.8	−3.1	Bee Branch	74	22	Oregon	6	26	3.43	−0.35	Dutton	6.58	Conway	1.08
California	48.0	+0.4	Santa Paula	92	1	Bodie	−9	4	1.44	−2.55	Branscomb	9.75	31 stations	0.00
Colorado	28.3	+2.5	Holly	76	20	Gunnison	−26	29	0.28	−0.54	Breckenridge	2.20	4 stations	0.00
Florida	58.1	−5.6	Orange City / Avon Park, Nocatee	85	24 / 25	Stephensville	−19	2	1.86	−1.02	De Funiak Springs	4.63	Miami	T.
Georgia	41.9	−5.2	Waverly	77	25	Diamond	10	27	2.22	−1.72	Oakfield	4.04	Woodbury	0.90
Idaho	27.2	.....	Blue Lakes	64	1	Chesterfield	−16	29	1.21	.....	Murray	2.60	Lost River	0.22
Illinois	24.1	−5.8	New Burnside	59	7	Lanark	−24	13	1.79	−0.56	Cairo	3.85	Martinton, Paris	0.29
Indiana	24.2	−7.7	Connersville	67	23	Hammond	−17	13	2.16	−0.72	Rensselaer	3.71	Indianapolis	0.58
Iowa	19.6	−3.9	Hopeville, Mt. Ayr / Osceola, St. Charles	58	31 / 31	Sibley	−27	13	0.41	−0.88	Ridgeway	1.96	Storm Lake	T.
Kansas	33.8	+0.1	Cunningham	73	30	Baker	−3	13	0.43	−0.61	Pleasanton	1.97	Hanover, Lebanon	0.00
Kentucky	30.7	−6.9	Alpha / Jackson	58	23 / 31	Beattyville / Scott	0	27 / 30	2.88	−0.69	Alpha	4.25	Scott	1.09
Louisiana	48.2	−4.0	State Ex. Station	85	24	Caspiana	17	6	3.92	−0.58	Minden	5.55	Venice	1.52
Maryland and Delaware	30.2	−4.7	Oakland, Md	60	20	Oakland, Md	−9	29	2.46	−0.79	Milford, Del	4.52	Westernport, Md	0.32
Michigan	19.0	−6.8	Mount Pleasant	43	24	Ironwood	−25	13	2.19	0.00	Kalamazoo	5.17	Plymouth	0.45
Minnesota	9.8	−6.0	Winnebago City	50	6	Pokegema Falls	−45	25	0.84	0.00	Mount Iron	2.73	Pipestone	0.13
Mississippi	42.9	−4.9	Natchez	80	24	Ripley	12	6	3.76	−1.05	Austin	6.63	Kosciusko	1.85
Missouri	30.2	−3.0	Arthur, Dean, Gano, / Neosho, Protem	65	31 / 31	Montreal	−11	13	1.51	−0.77	New Madrid	4.62	Rockport	0.13
Montana	27.2	+4.7	Chinook	65	1	Cut Bank	−27	14	0.72	−0.27	Lamedeer	2.00	Chinook	0.05
Nebraska	28.4	+1.3	Almar	66	2	Wakefield	−13	13	0.10	−0.52	Agee, Kennedy	0.40	17 stations	0.00
Nevada	30.4	−0.8	Martins Ranch	71	20	McAfee's Ranch	−9	7	0.14	−1.18	Battle Mountain	1.10	7 stations	0.00
New England*	22.3	−5.4	Narragansett Pier, R. I.	57	20	Van Buren, Me / Morrisville, Vt	−24	15 / 15, 19	3.18	−0.33	Cream Hill, Conn	6.65	Cornwall, Vt	0.85
New Jersey	28.6	−5.2	Lakewood / Beverly, Pemberton	55	13 / 20	Layton	−13	19	4.08	+0.36	Atlantic City	5.49	Trenton	3.20
New Mexico	34.5	−0.2	Carlsbad	84	2	Mountainair	−11	5	0.07	−0.60	Mountainair	0.52	7 stations	0.00
New York	21.2	−5.8	Oyster Bay	56	20	Indian Lake	−26	27, 29	2.76	−0.52	Number Four	9.56	Penn Yan	0.75
North Carolina	36.7	−5.7	Whiteville / Sloan, Wilmington	68	14 / 25	Linville	−7	1	2.16	−1.70	Hatteras	3.27	Marshall	0.60
North Dakota	11.6	−2.2	Jamestown	57	3	3 stations	−33	12–14	0.77	+0.18	Hamilton	1.67	2 stations	0.10
Ohio	23.4	−7.5	Coalton	57	13	Milligan / Warsaw	−11	17 / 28	2.07	−0.65	Milfordton	3.46	Somerset	1.17
Oklahoma and Indian Territories.	40.1	+0.8	Kenton, Okla.	73	2	Okeene, Okla.	7	13	0.64	−1.18	Webbers Falls, Ind. T	3.06	7 stations	0.00
Oregon	37.0	−0.2	Gold Beach	70	1	Pine	−3	30	3.16	−3.72	Glenora	12.37	Prineville	0.09
Pennsylvania	25.4	−5.5	Franklin	60	12	Dushore / Saegerstown	−14	27 / 29	2.66	−0.58	Girardville	4.83	Davis Island Dam	0.92
Porto Rico	74.8	.....	San German	95	12	Barros, Cidra	51	2	7.49	.....	Cidra	15.75	Coamo	1.01
South Carolina	41.0	−5.2	Bennettsville / Gillisonville / Walterboro	72 / 72 / 72	9 / 25 / 25	Spartanburg	10	27	1.95	−0.88	Smiths Mills	3.48	Barksdale	0.57
South Dakota	18.4	−2.4	Ashcroft	65	1	Forestburg	−34	13	0.65	+0.23	Aberdeen	1.86	Pine Ridge	0.09
Tennessee	34.9	−5.2	Waynesboro	67	31	Silver Lake	2	1	3.73	−0.51	Trenton	5.45	Elizabethton	1.56
Texas	50.3	+0.1	Cotulla	92	31	Mount Blanco	10	13	1.28	−0.92	Columbia	6.04	13 stations	0.00
Utah	26.4	−1.3	Tropic	76	1	Plateau	−26	27	0.37	−0.66	Park City	1.45	10 stations	0.00
Virginia	32.8	−5.7	Williamsburg	70	21	Marion	−4	1	1.98	−1.13	Elk Knob	4.21	McDowell	0.42
Washington	35.0	−0.1	3 stations	63	1, 5, 13	Lakeside	4	12	3.00	−2.44	Clearwater	11.21	Sunnyside	0.24
West Virginia	26.5	−8.4	Lillydale	59	25	Marlinton	−11	1	2.00	−1.17	Buckhannon	4.43	Moorefield	0.30
Wisconsin	12.7	−7.2	Prairie du Chien	50	7	Grand Rapids	−32	13	0.87	−0.46	Beloit	2.17	Menasha	0.23
Wyoming	24.4	+2.3	Phillips	67	1	Border	−21	28	0.64	−0.27	Battle	7.60	Fontenelle	T.

* Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, and Connecticut.

SPECIAL CONTRIBUTIONS.

RECENT PAPERS BEARING ON METEOROLOGY.

Dr. W. F. R. PHILLIPS, Librarian, etc.

The subjoined titles have been selected from the contents of the periodicals and serials recently received in the Library of the Weather Bureau. The titles selected are of papers or other communications bearing on meteorology or cognate branches of science. This is not a complete index of the meteorological contents of all the journals from which it has been compiled; it shows only the articles that appear to the compiler likely to be of particular interest in connection with the work of the Weather Bureau. Unsigned articles are indicated by a ——.

Science. New York. N. S. Vol. 19.

Bigelow, Frank H. The New Cosmical Meteorology. Pp. 30–34.

Scientific American. New York. Vol. 90.

—— Lunar Superstitions. P. 38.

Nature. London. Vol. 69.

Ramsden, W. Weather Changes and the Appearance of Scum on Ponds. P. 104.

Hillig, Fred J. Weather Changes and the Appearance of Scum on Ponds. P. 127.

—— The Ionisation of Atmospheric Air. Pp. 154–155.

Rotch, A. Lawrence. The Unusual Sky Colours and the Atmospheric Circulation. Pp. 173–174.

L., W. J. S. Indian Meteorological Memoirs. Pp. 178–179.

Everett, J. D. Rocket Lightning. P. 224.

Lee, W. A. Rocket Lightning. P. 224.

L., W. J. S. The Climate of South America. P. 230.

Journal of the Scottish Meteorological Society. Edinburgh. 3d Ser. Vol. 12.

Buchan, —. The Rainfall of Scotland in Relation to Sunspots. Pp. 117–127.

Buchan, —. Meteorology of Christmas Island. Pp. 128–133.

Watt, Andrew. The Climate of Hebron (in Syria). Pp. 133–152.

Muir, T. S. Temperature Observations at the Midstation on Ben Nevis. Pp. 152–159.

Dieckhoff, C. von. Note on Clouds at Fort Augustus. Pp. 159–160.
—— Ben Nevis Observatories: Memoranda as to proposed closure. Pp. 161–163.

London, Edinburgh, and Dublin Philosophical Magazine. London. 6th Series. Vol. 6.

Adams, E. P. Water Radioactivity. Pp. 563–569.
Simpson, George. On Charging through Ion Absorption and its Bearing on the Earth's Permanent Negative Charge. Pp. 589–598.
Townsend, John S. The Genesis of Ions by the Motion of Positive Ions in a Gas, and a Theory of the Sparkling Potential. Pp. 598–618.
McClung, R. K. The Relation between the Rate or Recombination of Ions in Air and the Temperature of the Air. Pp. 655–666.
Jeans, J. H. On the Kinetic Theory of Gases. Pp. 720–722.

Philosophical Transactions of the Royal Society of London. London. Series A. Vol. 202.

Chree, Charles. An Analysis of the results from the Kew Magnetographs on "quiet" days during the eleven years 1890 to 1900. Pp. 335–437.
Poynting, J. H. Radiation in the Solar System: its effect on temperature and its pressure on small bodies. Pp. 525–552.

Journal and Proceedings of the Royal Society of New South Wales. Sydney. Vol. 36.

Maiden, J. H. Forests considered in their Relation to Rainfall and the Conservation of Moisture. Pp. 211–240.
Liversidge, A. Meteoric Dusts, New South Wales. Pp. 241–285.

Journal of Geography. Chicago. Vol. 3.

L., E. M. [Influence of forests on local climate.] Pp. 47–50.

Proceedings of the Royal Society. London. Vol. 72.

Timiriazeff, C. The Cosmical Function of the Green Plant. Pp. 424–460.

Physical Review. Lancaster. Vol. 17.

Zahm, A. F. Measurement of Air Velocity and Pressure. Pp. 410–423.

Symons's Meteorological Magazine. London. Vol. 38.

Strachan, Richard. Use of the Rain Gauge on Shipboard. Pp. 196–197.
Smyth, John. Rainfall on the River Bann, County Down, Ireland, at Banbridge and Lough Island Reavy Reservoir, for 40 years, from 1862 to 1901. Pp. 198–201.

Astrophysical Journal. Chicago. Vol. 19.

Day, Arthur L. and Van Orstrand, C. E. The Black Body and Measurement of Extreme Temperatures. Pp. 1–40.

Bulletin of the American Geographical Society. New York. Vol. 35.

Ward, Robert DeC. The Climate of South America. Pp. 353–360.

Comptes Rendus de l'Académie des Sciences. Paris. Tome 137.

Kronecker, —. Le mal des montagnes. Pp. 1282–1283.
Vallot, J. Sur les modifications que subit la respiration par suite de l'ascension et de l'acclimatement à l'altitude du Mont Blanc. Pp. 1283–1285.

Annuaire de la Société Météorologique de France. Paris. 51me année.

Maillet, Ed. Sur divers points d'hydraulique sousterraine et fluviale. Pp. 185–188.
Moureaux, Th. La grande perturbation magnétique. Pp. 189–191.

Ciel et Terre. Bruxelles. 24me année.

—— La perturbation magnétique du 31 octobre 1903. Pp. 417–427.
Dobrowolski, A. Quelques idées sur la forme et sur la structure des cristaux de neige. Pp. 427–438.
Deslandres, H. Relation entre les taches solaires et le magnétisme terrestre. Pp. 478–485.

Bulletin de la Société Belge d'Astronomie. Bruxelles. 7me année.

L., E. La perturbation magnétique, 31 octobre–1er novembre 1903. Pp. 370–377.
Somville, —. La perturbation magnétique du 31 octobre 1903, à Uccle. Pp. 378–380.
Dumas, Léon. Météorologie et agronomie. Pp. 380–388.

Archives des Sciences Physiques et Naturelles. Genève. 4me période. Tome 16.

Dufour, Henri et Bührer, C. L'insolation en Suisse. Deuxième partie: Mesures actinométriques. Pp. 536–540.
Gautier, R. Résumé météorologique de l'année 1902 pour Genève et le Grand Saint-Bernard. Pp. 541–568.

La Nature. Paris. 31me année.

B., D. Poussières et lavage de l'air. Pp. 411–412.

La Nature. Paris. 32me année.

Rabot, Charles. Le recul des glaciers et la houille blanche. Pp. 7–10.

Annalen der Hydrographie und Maritimen Meteorologie. Berlin. 32 Jahrgang.

—— Erklärung der von der Deutschen Seewarte in den Witterungsberichten und Wettervorhersagen angewandten Ausdrücke. Pp. 5–11.

Das Wetter. Berlin. 20 Jahrgang.

Meinhardus, Wilhelm. Ueber einige bemerkenswerte Staubfälle der letzten Zeit. Pp. 265–278.
Vanderlinden, E. Der Nebel in London. Pp. 280–282.
Schwarz, L. Staubfall. Pp. 281–282.
Knab, Carl. Staubregen. P. 284.
Triebel, Louis. Sturm. P. 284.
Offig, —. Sandnebel. Pp. 284–285.
Schwarz, L. St. Elmsfeuer und Sturm auf der Schneekoppe zu 21 November 1903. Pp. 285–286.

Gaea. Leipzig. 39 Jahrgang.

—— Untersuchungen über vertikale Luftströmungen. Pp. 22–24.
—— Die klimatischen Verhältnisse von Pará. Pp. 33–40.
—— Einfluss der Luftkompression auf den Menschen. [Review of article of Kabrhel.] Pp. 56–57.
—— Die Wirkungen der Luft in grosser Höhe auf den Menschen. [Review of article of A. Masso.] Pp. 57–58.

Physikalische Zeitschrift. Leipzig. 4 Jahrgang.

Gerdien, H. Registrierung der Niederschlags-Elektrizität im Göttinger Geophysikalischen Institut. Pp. 837–842.

Illustrierte Aëronautische Mitteilungen. Strassburg. 7 Jahrgang.

Börnstein, R. Bericht über die Möglichkeit elektrischer Ladung und Entzündung von Luftballons. Pp. 395–399.
Volkmann, Wilhelm. Ueber die Bedingungen, unter denen die elektrische Ladung eines Luftballons zu seiner Zündung führen kann. Pp. 399–405.

Annalen der Hydrographie und Maritimen Meteorologie. Berlin. 31 Jahrgang.

Paulus, A. Schwerer Orkan im Korallenmeer im März 1903. Pp. 521–525.
Buchholz, —. Die Witterung zu Tsingtau im März, April und Mai 1903, nebst einer Zusammenstellung für das frühjahr 1903. Pp. 526–529.

ON THE USE OF SOUNDING BALLOONS FOR METEOROLOGICAL OBSERVATIONS AT GREAT HEIGHTS.

Note by Ch. Renard, translated from Comptes Rendus, Paris, 1892, vol. 115, pp. 1049–54.

I have the honor to present to the academy a memoir on the employment of unmanned balloons for making meteorological observations at great heights; this note is a summary of that memoir.

If we could ignore all anxiety on account of the dangers to which the aeronaut is exposed in the upper regions, it would appear very easy for balloons to attain great heights. This facility is, however, only apparent. In reality, the atmosphere presents itself to us like a mountain whose slopes are at first very gentle, but change rapidly into a perpendicular wall.

For the sake of simplicity let us suppose that the temperature of the air is uniform and equal to 0° C., then by neglecting the feeble variations of g, or gravity, with the altitude, this would give:[1]

$$y = 18400 \log n,$$

where y is the altitude in meters above the plane where the pressure is 1 kilogram per square meter. n is the reciprocal of the pressure, or the denominator of the fraction $1/n$, which expresses the pressure in kilograms per square centimeter.

[1] The fundamental differential equation for barometric hypsometry is:

$$dp = -wdh,$$

where w is the weight of a unit volume of the air at the given pressure p, and absolute temperature (T) and under the constant force of gravity, but the weight of a unit volume is as its density ρ and is connected with the pressure and temperature by the relation

$$pv = p\frac{1}{\rho} = \frac{p}{w} = RT,$$

where R is a constant, whence

$$dp = -\frac{p}{RT}dh,$$

assuming with M. Renard that the temperature of the air is constant and equal to 0° C., the T becomes the constant 273° C. and $RT =$ the constant 273 X (29.2713). The intergation of this equation gives us nap. $\log p = -\frac{h}{RT} +$ constant.

When $p = 1$ kilogram per square centimeter the altitude is hh_1, and the arbitrary constant becomes $\frac{h_1}{RT}$, whence

$$\text{nap. log } p = \frac{1}{RT}[h_1 - h]$$

or

$$h - h_1 = RT \text{ nap. log } \frac{1}{p}.$$

If ordinary or Briggs' logarithms are used, this becomes

$$h - h_1 = \frac{RT}{Mod.} \log \frac{1}{p}.$$

On the other hand, the following relation is easily established: For a balloon having only itself to carry and in equilibrium at a pressure of $1/n$,

$$V = \frac{36\pi m^3 n^3}{A^3}.$$

V = volume of the balloon in cubic meters.

m = superficial density of the envelope (weight in kilograms per square meter).

n, the reciprocal of the pressure as defined above.

A, ascensional force, in kilograms, of a cubic meter of gas at a pressure of 1 kilogram per square centimeter.

This equation between three cubics shows with what rapidity the volume of the balloon increases as the envelope becomes heavier, as the final pressure diminishes, and as the density of the gas approaches that of the air.

Illuminating gas has an ascensional force equal to two-thirds of that of ordinary hydrogen. The substitution of that gas for hydrogen would have the effect of increasing the volume of the balloon in the proportion of 2^3 to 3^3 or of 1 to 3.38. It is, therefore, necessary to use hydrogen.

The ordinary material of manned balloons weighs 300 grams per square meter. I have succeeded in making one that weighs 50 grams per square meter. This substitution reduces the volume of the balloon in proportion of 216 to unity.

Let us, therefore, use this lighter covering (or $m = 0.050$) and ordinary hydrogen, for which $A = 1.122$. The cubical equation now becomes—

$$V = 0.01\ n^3.$$

This gives an astonishing progression, as follows:

n	5	10	40	300	500
y in meters	12900	18400	29500	42300	49700
V in cubic meters	1.25	10	640	80000	1250000

The figures in this table speak for themselves.

The atmosphere, at first so easy to ascend, seems soon to be bounded as by a brass ceiling. Heights of 12 to 15 kilometers can be attained with small spheres of a few cubic meters; twice that altitude requires hundreds; thrice, requires tens of thousands; four times that height, millions of cubic meters.

By eliminating n from the above equation in three cubics, we find that the expression for the altitude may take the form—

$$y = M + 6133 \log V,$$

where M is a constant that is a function of m and A only.

If we put $y = h - h_1$ = altitude above the plane for which the pressure is unity and $n = \frac{1}{p}$ = reciprocal of the pressure at the altitude F, we obtain the formula as written by M. Renard.

$$y = 18400 \log n.$$

The relation between n and p may also be expressed in the following table:

b. Barometrical column.	p. Pressure in kilograms per square centimeter.	$n = 1/p$.
Millimeters.		
800	10.877	0.09194
760	10.333	0.09678
720	9.789	0.10216
680	9.245	0.10817
640	8.701	0.1149
600	8.158	0.1226
560	7.614	0.1313
520	7.070	0.1414
480	6.526	0.1532
440	5.983	0.1671
400	5.439	0.1839
300	4.079	0.2452
200	2.720	0.3676
100	1.360	0.7353
73.55	1.000	1.00
36.8	0.500	2.00
24.5	0.333	3.00
18.4	0.250	4.00
14.7	0.200	5.00
7.4	0.100	10.00
9.8	0.025	40.
0.22	0.003	300.
0.15	0.002	500.

If we make $A = 1.122$, as for common hydrogen, the value of M becomes—

$$M = 11675 - 18400 \log m.$$

The first equation shows that by increasing the volume tenfold, y is increased by a constant quantity equal to 6133 meters only.

These two equations enable me to construct some diagrams illustrating, so to speak, the obstacle that opposes the ascensions of our sounding balloons.

The level lines of these diagrams correspond to constant values of V; by giving to V values differing successively by 1 square meter the level lines are seen to draw closer together and coalesce in one continuous line. This is a first limit, which can only be passed over by increasing tenfold the order of the size of the volumes.

At 6133 meters higher there is a new limit rendering a new tenfold increase, and so on.

The other diagrams show the influence of the weight of the covering m and of the probable load of the balloon.

I now come to the construction of the sounding balloon, which I expect soon to try. I have been able to limit its diameter to 6 meters and its volume to 113 cubic meters, by making use of a very light covering of Japanese paper rendered waterproof by a special kind of varnish. This covering weighs only 50 grams per square meter.

In regard to the instruments, I first turned my attention to the barograph and the thermograph.[2] M. Richard furnished me with instruments weighing 2.8 kilograms each; by the use of aluminium and by cutting out whatever was unnecessary I have reduced their weight to 1200 grams each.

My great anxiety was to preserve the apparatus from shocks on landing; the parachute which I present to the academy resolves this problem appropriately. It consists of a cage which may be thrown from a height of 2 meters upon a hard soil without at all interrupting the movements of the clockwork of the instruments placed within it.

All this apparatus is nearly completed. First, there is the net of linen thread, weighing only 0.632 kilograms, and breaking only by a strain of 650 kilograms. I have the honor, also, to present the barograph, the thermograph, their protecting cages and parachutes, and, finally, several samples of the covering of the balloon. The total weight, including instruments, will not exceed 9.5 kilograms.

The altitude reached will be about 20,700 meters and the pressure at the moment of stopping will be reduced to 55 millimeters of mercury.

My object in making this communication is not by any means to lay claim to priority in the conception of these aerial soundings; I have simply wished to define the limits imposed upon us by the nature itself of the matter and, in the second place, to make known the results of my investigations into the subject of the light coverings, instruments, and light parachutes, without which a continuous and regular series of aerial soundings is practically impossible.

ON THE ASCENSION OF CLOSED RUBBER BALLOONS.

By H. HERGESELL. (Translated from the Illustrirte Aëronautische Mittheilingen, May, 1903, Vol. VII, pp. 163-168.)

A balloon whose envelope consists of very extensible india rubber, can be used for ascensions when it is tightly closed. The great advantage of this is that in ascending no loss of gas takes place; in going up, the balloon will expand more and more and can attain great heights before bursting. The ascent ceases when a rent occurs in the envelope. If instruments are carried up, an arrangement must be provided that will prevent a precipitous descent. Assmann, to whom we are indebted for the method just described, of employing

[2] M. Violle is just now having a light actinometer constructed for these experiments. M. Ch.-Ed. Guillaume is occupied with a bathometer.

closed balloons, utilizes a parachute for this latter purpose. On the other hand, a somewhat smaller and less inflated second balloon may be used in the same way; this would burst later on account of being less distended, and would begin to fall to the ground immediately after the bursting of the larger balloon. This smaller balloon offers enough resistance to the air to prevent a rapid fall, and as it is sufficiently filled to float alone, may serve as a signal balloon to attract the attention of those in quest of the instruments.

In the following paragraphs the conditions of ascension of a distended balloon will be more closely examined:

Let the mass of the gas in the balloon be M kilograms and the volume at any time V, then we have the relation $M = Vs_g$, where s_g expresses the specific weight of the interior gas.

If B is the weight of all solid parts of the balloon (the envelope, the parachute, the instruments, etc.) then the force of ascension or buoyancy is:

$$A = V(s_a - s_g) - B = M\left(\frac{s_a}{s_g} - 1\right) - B,$$

where s_a is the specific weight of the air. Let n be the ratio of the specific weight of the air and of the buoyant gas, then $A = M(n-1) - B$, so that when M and B are constant, A will depend only on n. The laws of gases give us the relation

$$s_a = s_{ao}\frac{p_a}{p_o}\frac{T_o}{T_a}$$
$$s_g = s_{go}\frac{p_g}{p_o}\frac{T_o}{T_g},$$

where s_{ao} and s_{go} are the specific weights for a given pressure p_o and for a certain temperature T_o (in absolute measurement).

It therefore follows that

$$n = \frac{s_{ao}}{s_{go}} \times \frac{p_a}{p_g} \times \frac{T_g}{T_a} = n_o \frac{p_a T_g}{p_g T_a}.$$

In consequence of the pressure of the elastic balloon envelope, p_g will in general be somewhat larger than p_a. For the same reason T_g will differ from T_a by a certain amount. If we put $p_g = p_a + \Delta p$ and $T_g = T_a + \Delta T$, then

$$n = n_o \frac{p}{p + \Delta p}\frac{T + \Delta T}{T}.$$

The magnitude of Δp can be learned by experiment. For this purpose an india rubber balloon was gradually filled, and the excess of pressure was measured by an attached water manometer. At each step the volume was determined simultaneously. The following table contains some of the results:

TABLE 1.

Diameter.	Volume.	Excess of inside pressure of mercury.
Millimeters.	*Cubic centimeters.*	*Millimeters.*
0.81	0.38	20.0
1.08	0.59	27.5
1.42	0.89	26.8
1.72	1.18	24.5
1.82	1.29	22.5
2.40	1.95	21.1
2.66	2.27	20.0.
3.02	2.83	19.5
3.72	3.76	17.3
4.28	4.64	15.7
4.62	5.20	17.5
5.02	5.87	16.3
5.20	5.92	16.5

We see, therefore, that the pressure increases at first with increasing volume. A certain maximum is, however, soon attained, and this occurs with a relatively small increase in the volume of gas. As the balloon expands still further the pressure again decreases. The bursting of the balloon occurs at a comparatively small pressure. This phenomenon is undoubtedly connected with the elastic behavior of the caoutchouc. In every case the experiments show that Δp at bursting was less than 2 millimeters of mercury. We may neglect the excess of pressure without serious error.

It is difficult to determine by experiment the magnitude of ΔT, as it depends upon the influence of radiation on the balloon. According to measurements already mentioned in this periodical (Illustrirte Aëronautische Mittheilingen, III, 1899, p. 109), the amount of excess may become very considerable. It is, however, to be observed that india rubber balloons must always be inflated with compressed hydrogen, so that the gas is comparatively cool when it enters into the balloon. On this account the equality of the inner and outer temperature will first occur at some definite altitude and ΔT will become positive from this point upward. If we put $\frac{\Delta T}{T} = \tau$, then $n = n_o(1+\tau)$ and $A = M[n_o(1+\tau) - 1] - B$.

We will now compute the volume and thence the radius of the inflated balloon, which corresponds to a definite air density, s_a.

From the equation $M = Vs_g = \frac{Vs_a}{n}$ there follows

$$V = \frac{Mn}{s_a}.$$

If we take n as a constant, that is to say, if we ignore the influence of the temperature of the interior gas, then v is inversely proportional to the density of the air.

Since $V = 4\pi r^3/3$ it follows that the diameter of the balloon is given by the equation

$$d = \sqrt[3]{\frac{6Mn}{\pi}} \times \frac{1}{\sqrt[3]{s_a}}.$$

If d_o is the diameter when the density is s_{ao}, then we have

$$\frac{d}{d_o} = \sqrt[3]{\frac{s_{ao}}{s_a}}.$$

If we do not ignore the influence of temperature, then the last formula will be

$$\frac{d}{d_o} = \sqrt[3]{\frac{s_{ao}}{s_a}\frac{n}{n_o}} = \sqrt[3]{\frac{s_{ao}}{s_a}(1+\tau)}.$$

Hence, the diameter of an inflated balloon at different altitudes varies inversely as the cube root of the density of the air at those altitudes. It is more convenient to introduce the air pressure instead of the air density. The formula then becomes

$$\frac{d}{d_o} = \sqrt[3]{\frac{p}{p_o}\frac{T_o}{T}(1+\tau)}$$

which may be written approximately thus:

$$\frac{d}{d_o} = \sqrt[3]{\frac{p}{p_o}}$$

The rate of ascension of a self-registering balloon is of the greatest interest, since this regulates the ventilation of the thermometer carried up with it. During the ascensional movement the resistance of the air at any moment is very nearly equal to the buoyancy. If we call the cross section of the ascending system Q, the vertical velocity v, and the coefficient of resistance k, therefore we have

$$kQv^2 s_a = A = M(n-1) - B.$$

From this there follows

$$v^2 = \frac{A}{kQs_a}.$$

We must express Q as a function of s_a; we have

$$d = d_o \sqrt[3]{\frac{s_{ao}}{s_a}},$$

and consequently,

$$A = \frac{d^2\pi}{4} = \frac{\pi d_o^2}{4}\left(\frac{s_{ao}}{s_a}\right)^{\frac{2}{3}},$$

so that for v^2 we have:

$$v^2 = \frac{4A}{\pi k d_o^2 s_{ao}} \sqrt[3]{\frac{1}{s_a}},$$

for which we can also write,

$$v^2 = \frac{4A}{\pi k d_o^2 s_{ao}} \sqrt[3]{\frac{s_{ao}}{s_a}}.$$

But $v_o^2 = \frac{4A}{\pi k d_o^2 s_{ao}}$ is the vertical velocity of ascent, corresponding to a definite density s_{ao} of the air, and to the corresponding buoyancy appropriate to it. With this notation we obtain

$$v^2 = v_o^2 \sqrt[3]{\frac{s_{ao}}{s_a}} \quad \text{or} \quad v = v_o \sqrt[6]{\frac{s_{ao}}{s_a}},$$

or approximately

$$v = v_o \sqrt[6]{\frac{p_o}{p}}.$$

Hence, the velocities of ascent are inversely as the 6th root of the corresponding air pressures.

According to the preceding the maximum height that an elastic balloon can attain depends not at all on the size of the balloon, the nature of the gas with which it is filled, etc., but only upon the capacity of the material for elastic expansion. The greater the volume of the elastic covering can become without bursting, so much the greater the height. The size of the balloon is only to be considered in so far as that it must be sufficient, without being too greatly expanded, to give the buoyancy necessary in order to raise the balloon and the instruments. The balloons used heretofore, as furnished by the Continental Gummifabrik in Hanover, can easily stretch to double their diameter without bursting. Therefore, the height they will attain is about 18,000 meters.

The following table will be of use in the employment of india rubber balloons. The first column shows the density of the air, the second the altitude, the third the ratio $\frac{d}{d_o}$, the fourth the ratio $\frac{v}{v_o}$, the fifth the ratio of the ventilation, or of the mass of air flowing past the balloon.

TABLE 2.

Density of the air.	Altitude.	d/d_o	v/v_o	q/q_o	Density of the air.	Altitude.	d/d_o	v/v_o	q/q_o
	Meters.					*Meters.*			
1.25	20	1.00	1.00	1.00	0.50	8500	1.36	1.16	0.46
1.19	500	1.02	1.01	0.96	0.47	9000	1.39	1.18	0.44
1.13	1000	1.04	1.02	0.92	0.45	9500	1.41	1.19	0.43
1.07	1500	1.05	1.03	0.88	0.42	10000	1.44	1.20	0.41
1.01	2000	1.07	1.04	0.84	0.37	11000	1.49	1.22	0.36
0.96	2500	1.09	1.04	0.80	0.32	12000	1.57	1.25	0.32
0.91	3000	1.11	1.05	0.77	0.27	13000	1.67	1.29	0.28
0.87	3500	1.13	1.06	0.74	0.23	14000	1.76	1.33	0.25
0.82	4000	1.15	1.07	0.70	0.19	15000	1.87	1.36	0.21
0.78	4500	1.17	1.08	0.67	0.18	16000	1.91	1.38	0.20
0.74	5000	1.19	1.09	0.65	0.16	17000	1.99	1.41	0.18
0.70	5500	1.21	1.10	0.62	0.14	18000	2.07	1.44	0.16
0.66	6000	1.24	1.11	0.58	0.12	19000	2.18	1.48	0.14
0.63	6500	1.26	1.12	0.56	0.11	20000	2.25	1.50	0.13
0.59	7000	1.29	1.13	0.54	0.08	22600	2.27	1.51	0.10
0.56	7500	1.31	1.14	0.51	0.06	24000	2.28	1.51	0.08
0.53	8000	1.33	1.15	0.49					

Table 2 shows that very considerable heights can be attained with closed rubber balloons if they can expand to more than twice their original diameter. In practise, however, the misfortune is often noticed that the envelopes in expanding develope small holes through which the gas rapidly escapes. In such cases it happens that the balloons do not explode although the altitudes that they can attain under such circumstances are very considerable, such as 12,000–13,000 meters.

However, in such cases we lose one advantage which Assmann more especially has pointed out, namely, that a closed balloon ascends with increasing velocity and does not maintain any position of equilibrium. The leaky balloon floats for some time at the highest altitude, so that the thermometers have no proper ventilation, and then descends too slowly. On this account, it would be well in all cases to give the balloon, by a strong distension in the beginning, a more than sufficient upward impulse, so that in the first place it will certainly explode, and in the second place be sufficiently ventilated. The fact that the velocity varies inversely as the 6th root of the pressure, therefore, increases somewhat slowly, makes a great velocity in the beginning particularly desirable.

If we take the product of the vertical velocity by the density of the air as the measure of the ventilation, then in the vicinity of the surface of the earth and at 4 meters per second this will be 5, but at an altitude of 20,000 meters where the velocity, according to our table, has risen to 6 meters per second, the ventilation will be 0.65. The latter figure is certainly no longer sufficient to protect even well sheltered thermometers against radiation. According to our experience we must attain a value of 1. This figure, however, requires an initial ascensional velocity of 5.7 meters per second, a velocity that can easily be given to rubber balloons. For still greater maximum altitudes a still greater initial velocity must be given. For these ascending velocities, however, one must use very sensitive instruments and not sluggish thermometers. In Strasburg, since the introduction of the closed rubber balloons, we have with great success used the tubular thermometer, described by me in the protocol of the Conference of the International Commission for scientific balloon ascensions at Berlin. This thermometer has a sensitiveness more than sufficient to enable it to record properly during the above desired velocity of ascension; it also possesses the lightness (weighing with the clock and protecting case 560 grams) necessary to make it possible to rise with rubber balloons of 1.50 meters diameter.

The further advantages possessed by the rubber balloons have been so fully described by the inventor, Dr. Assmann, in the protocol to the above-mentioned conference that I do not need to go into any further details. I will only close with the wish that they may be used frequently and with good results.

DETAILED CLOUD OBSERVATIONS. A PROGRESSIVE PHASE IN WEATHER FORECASTING.

By Rev. FREDERICK L. ODENBACH, S. J., dated January 8, 1904, Meteorological Observatory of St. Ignatius College, Cleveland, Ohio.

Isobars have formed the stepping stones on which weather forecasting has mounted to take its place among the sciences. The daily survey of the atmosphere and the publication of weather maps have enabled meteorologists to bring out these facts; that the *nature* of our weather depends on the configuration of isobaric lines, but its *intensity* on their gradient. With these two principles to start with, a few decades have sufficed to develop a method of forecasting that has met with very encouraging results and has been of great value to most varied classes of interests. But, in spite of these successes, there is a prevailing conviction among forecasters that in the face of great difficulties progress, at the present time, is checked.

In spite of telegraphic systems and the map material at our disposal twice each day, certain obstacles bar our further advance which may be summed up as follows:

1. We miss many an important detail in the map.

2. We are often left ignorant of the sudden formation or dissolution of highs and lows, or of changes in their intensity.

3. The irregular progress of some isobaric systems can not be detected on, or inferred from, even the most perfect map. The initiated will hardly call for a proof of this statement. But how are we to mend our condition? A thousand stations would hardly bring out the necessary detail in a map; and, even if they did, the changes in atmospheric conditions would

make the map unreliable for the hours which intervene between the morning and the evening report. Moreover, a change may occur even during the short space of time that elapses between the observations and the compilation or utilization of the map. Continuous teleometeorology might offer an efficient remedy, but that must be considered, for the present at least, as a scientific utopian dream.

Much diligence and eminent talent are being brought to bear on meteorological problems. There is great activity everywhere; the atmosphere is sounded by means of kites and balloons, data are collected and collated, but the results apparently answer the "how" and the "wherefore" of the theorist, rather than the pleading "what" and "when" of the solitary forecaster, to whom the public looks for definite information, and who stands or falls by his personal wits.

It is fair, therefore, to say that the weather map alone, though an indispensable help, will not advance the science of forecasting much beyond its present stage. We have read everything out of the map which seems contained in it: still we are often at a loss, often at fault. It will be wise, therefore, to look elsewhere in the hope of striking a new trail, which will advance us another step such as that taken when we began to consider the configuration of isobars.

For quite a run of years, while constantly and diligently observing the clouds [as they come and go in their varied forms and directions, their different colors and speeds] the conviction has firmly taken hold of me that they have more to tell than we have hitherto supposed. I believe that a systematic and detailed study of the clouds will, to say the least, advance us one more step in the science of forecasting. Possibly that step may be much more progressive than we can or dare imagine at the present moment.

This conviction is chiefly based on my personal experience; yet it seems that any one who considers the nature of clouds ought to come to the same conclusion. Clouds are the immediate product of weather conditions, not indeed directly overhead, but at some distance from us. We have here a relation of cause and effect. Similar causes are followed by similar effects. The combination of weather elements is varied, but any variation here will produce a corresponding change in the effect, namely in the clouds. I would, therefore, consider cloud as an index; as a hieroglyphic language of the weather, if you will, written against the blue sky. If they are unintelligible to us it is not nature's fault; she never writes in meaningless scrawls.

What attempt has thus far been made to decipher this script? We have picked out ten or a dozen cloud forms and observed these in a way. But is it reasonable to expect that the ever changing weather in its endless variety can be depicted by means of 10 simple signs? Abercromby seems to me to contradict himself, when he writes within the space of three pages the two following passages. After referring to his catalogue of 10 cloud forms, he says:[1]

> Almost all the smaller varieties are so rare or transient that for practical purposes they be neglected, but if, on the contrary, the 10 main words are restricted to the forms of cloud we have described under them * * * then the author can say, from experience of cloud observation in all longitudes and in latitudes ranging from 72° north to 55° south, that 90 per cent of skies in every part of the world can be sufficiently accurately defined by these 10 words.

Two pages further on he remarks:[2]

> We have seen that there is a fine-weather cumulus, as well as cumulonimbus, a fine-weather, as well as a dangerous cirrus, while fleecy clouds have not the same import in London as on the equator. In practise, the good and bad forms can rarely be mistaken, but sometimes very difficult cases arise. Clouds, in fact, tell us by their appearance, what might be written in words, that more or less damp air is rising or falling under certain conditions of upper and lower wind currents; the significance must be judged by the surroundings and antecedents, just as the sense of many words can only be judged by the context.

[1] Weather, p. 118. [2] Ibid, p. 120.

We must remark, that there is nothing so small in nature that we may neglect it with impunity. It may be possible with these 10 forms to define the general appearance of 90 per cent of skies; but 95 per cent of observers would be able to conclude precious little about the weather conditions under skies so vaguely described. Then the certain conditions, the surroundings and antecedents, which are written in the clouds—these are the very things we wish to get at, and I doubt seriously if 10 words are sufficient to describe the great number of combinations formed by weather factors, whose existence must be and is expressed in cloud language.

Here, then, is evidently an opportunity for progress. Cloud language and cloud dialect seem to promise the much coveted aid, and perchance this language will be as serviceable as is the incomparable barometer.

If the sky were as intelligible to us as is the daily weather map with its isobars, isotherms, wind direction, and velocity, we could follow weather changes with something like the certainty of a skilled physician watching the symptoms of his patient toward recovery or total collapse. This knowledge, and the facility in using it, can be acquired only with patient and systematic labor. We must study the letters, the words, and phrases of cloud language. In the beginning, no doubt, it will be a task no less arduous than that undertaken by those who first deciphered hieroglyphic inscriptions, but it seems no less promising.

Some progress has already been made along these lines. We have the 10 cloud forms, laid as a foundation by the international cloud committee. Blue Hill, Upsala, and several other observatories have done very efficient work. Still these are isolated attempts, and it is to be feared that there are too few who are really interested in this important subject, owing to its primitive condition, and perhaps to a lack of methodical directions in its pursuit.

For these reasons I have attempted to put the subject in the light in which I view it, and will give the classification used at the Meteorological Observatory of St. Ignatius College, together with some of our methods, reserving the finer details for subsequent articles if the subject should prove interesting to the readers of the REVIEW.

Many will, no doubt, be shocked by our elaborate catalogue of cloud varieties, but it has already been stated that the simple, though fundamental divisions of the International Cloud Committee can do nothing to advance the science of forecasting. These are a part of the A, B, C of cloud language, and will remain so unless we progress.

Abercromby has correctly stated the practical object of cloud study when he says:[3]

> The foundation of all modern cloud knowledge turns round the relation of cloud forms to shapes of isobars.

Now, there are more than 10 staple forms of clouds, each of which has its own peculiar significance, because it is the product of a peculiar combination of weather factors, and we can not, therefore, neglect any one of them without running the risk of leaving a very serious gap in the systematic knowledge we are anxious to acquire. It will be our task to recognize and record all staple cloud forms, together with the atmospheric conditions that precede, accompany, or follow them. If I am told that cirrus preceded a certain storm, I know very little, since I have many forms of cirrus in mind, and it would interest me to know precisely which form was observed in that particular case, and, more than this, there are many interesting, intelligible points about every cloud that demand recognition and interpretation. It is evident, therefore, that cloud language and cloud study can not be so simple as seems to have been taken for granted in all instructions to observers; one will prove as complicated as the other.

[3] Weather, p. 122.

In setting forth our system of species and varieties I have added no definitions, as the names, for all present purposes, are sufficiently self-explanatory. It has been my endeavor to make the classification as rational and exhaustive as possible.

Hence, principles of division were assumed, which will cover the whole field, and are so simple and elastic that they may be applied to the most peculiar climate or sky. In judging of the detail in classification, I would caution the reader to remember that this is the particular dialect of cloud language as it is found in and around Cleveland, Ohio. How it would work in other regions I know not, though it occurs to me that several good exact monographs for special localities could later on easily be reduced to a universally practical system.

Dr. Hann remarks in a note to his chapter on cloud classification:[4]

> The inexpedience of attempts to classify clouds on purely genetic and physical principles, i. e., without a morphological basis, has been insisted on repeatedly.

The reasons are plain. Our present knowledge of the causes of different cloud forms is too limited to establish a natural classification. Even if we understood the genesis of cloud forms, the human eye and the cloud forms will always remain the only factors on which the observer must rely for his indications of the coming weather.

What is desired, therefore, is an exhaustive, or, at least, an expansive system of cloud forms, even if it be artificial, around the elements of which we may group the results of our observations. Our classification of clouds will naturally follow the same laws and pass through the same stages as did the zoological and botanical systems of Linnæus.

CLOUD CLASSIFICATION.

Grand division (principle of division—the nature or material of the cloud).

Class I. Ice clouds: Crystals.
Class II. Watery clouds: Solid water particles.

Subdivision into families (principle of division—the extension of the cloud).

Family I. (The line.) Cirrus: Fiber clouds.
Family II. (The surface.) Stratus: Layer clouds.
Family III. (The solid.) Cumulus: Lump clouds.

With these five elements, obtained by dividing according to nature and extension, we have five genera of clouds, a division which is exhaustive and comes very near to that of Howard.

The five genera.

1. Cirrus.
2. Cirro-stratus.
3. Cirro-cumulus.
4. Stratus. (*a*) Alto-stratus.
   (*b*) Low stratus.
5. Cumulus. (*a*) Alto-cumulus.
   (*b*) Low cumulus.

Division into species (principle—the general outline or extension).

Ice cloud.—High level, 20,000 to 27,000 feet:

Cirrus. (1) Fiber.
(2) Streamer.
(3) Plume.
(4) Wisp.
Cirro-stratus. (5) Band.
(6) Bar.
(7) Patch.
(8) Veil.
Cirro-cumulus. (9) Cirro-cumulus pellets.
(10) Cirro-cumulus balls.

Water cloud.—Central level, 12,000 to 15,000 feet:

Alto-stratus. (11) Gauze.
(12) Band.
(13) Patch.
(14) Cover.
Alto-cumulus. (15) Alto-cumulus balls.
(16) Alto-cumulus plates.

Water cloud.—Lower level, 2000 to 6000 feet:

Stratus. (17) Sheet.
(18) Cover.
Cumulus. (19) Woolpack.
(20) Mountain.
(21) Roll-cumulus.
(22) Strato-cumulus.
(23) Wrack.
(24) Fog.

From the above it is apparent that clouds may be naturally and exhaustively divided into species on the principle of general outline. There are, however, differentiations of species constituting varieties, which, though easily and generally overlooked, are of the very greatest import, since every turn in a staple form must have a corresponding cause in the combination of weather factors that produced it; and it is here that we depart on new lines. What others have heretofore designated trifles, that we now take up, suspecting them to contain the very knowledge we are after.

Differentiations (constituting varieties) may be observed in:
(*a*). The general outline.
(*b*). The surface.
(*c*). The organization.

OUTLINE.	SURFACE.	ORGANIZATION.
Hooked.	Undulating.	Flaky.
Bent.	Drifted.	Granulated.
Branched.	Banked.	Lumpy.
Pectinate.	Warped.	Watery.
Screwed.	Rippled: (*a*) Plain. (*b*) With interference.	Fibrous.
Curved.	Furrowed.	Marbled.
Tangled.	Striated: (*a*) Lengthwise. (*b*) Across. (*c*) Obliquely.	
Headed: (*a*) Forward. (*b*) Backward.		
Wispy.		
Tapering.		
Feathery.		
Fleecy.		
Fringed.		

A combination of one of these adjectives with one of the names in the list of species makes it possible to perfectly designate and register a large number of staple cloud forms.

Certain storm clouds are so independent and so well organized that special terms are required to fully describe them. They exhibit peculiar developments, which I will call processes.

1. Mammæ.
2. Antlers.
3. Beards.
4. Trailers.
5. Fringe.

The well-developed thundercloud shows some or all of the following processes:

At top: (1) Beak (forward).
(2) Spur (rear).
Below: (1) Ram (front).
(2) Rudder (rear).

[4] Lehrbuch, p. 263. [Germ. Ed.]

These four, when they occur combined together, have long ago suggested the name of anvil cloud. Besides this classical form I may mention:

1. Cloud wedge.
2. Crescent.
3. Funnel.
4. Umbrella cloud.

Thus far I have made use of form only and have shown that all clouds may be fully described according to a uniform principle. But it is not the form only which has its story to tell; on the contrary, form tells but half the history of the cloud. If we desire to derive all the information possible we must take in the accidentals. These may be grouped under the following heads:

1. Condition.
2. Motion.
3. Distribution.
4. Color.

Condition:

1. Well defined. } Species or varities.
2. Ill defined. }
3. Stable.
4. Forming.
5. Breaking up.
6. In transformation: From—to.

Motion:

1. Slow.
2. Rapid.
3. Average.
4. Boiling.
5. End on.
6. Broad side on.
7. Aslant.
8. Direction whence.

Distribution:

1. Isolated.
2. Scattered.
3. Flocked.
4. Aligned.
5. Radiate.
6. Continuous.
7. Coalescing.

Color:

1. White.
2. Gray.
3. Blackish.
4. Red.
5. Yellow.
6. Green.
7. Iridescent, with.... as prevailing color.

The program of a single cloud observation will be, as follows:

We are to determine, (1) the species and variety; (2) processes; (3) conditions; (4) elements of motion; (5) distribution; (6) color; (7) configuration of isobars.

The answers to the first six points are entered by means of symbolic signs in one column of a journal, and in a column parallel to this are to be entered the configuration of isobars, together with the state of the weather. Regarding the configuration of isobars, it is evident that most attention must be paid to that system under whose control the observer happens to be at the time of observation. The final and crowning work will be the collating of the two columns. These will in the course of time show repetitions, regularly recurring associations of cloud forms and type of weather, and *such regular associations are the expression of a law of nature:* they will form laws for the forecaster. By such method only shall we reach any practical results in cloud study. In way of consolation for those who find this method too elaborate or too difficult, I will quote a few lines from Clement Ley.[5]

All said then, and done, the land of clouds is not entirely one of fancy. The art of distinguishing and of usefully employing the distinctions between the varieties of cloud is not nearly so difficult as many an art in which the amateur engages himself for the sake of amusement, and a very cursory acquaintance with the labors of many writers—especially, if it is not insidious to say this of German and American writers—satisfies every one as to the fact that there is also a science of nephology, nascent though this science may be. How can practise and knowledge be most successfully promoted?

To this question, as put by Mr. Ley, I would answer: By systematic and detailed cloud observations; by attending to the so-called *trifles.*

[5] Cloudland, p. 201.

I might enter into some very interesting details myself, but since it is my object to show that cloud study, as a scientific branch of meteorology, is something more than noting one of 10 cloud forms opposite a given date, but I will close, hoping that some of the readers of the REVIEW will interest themselves in one of nature's most interesting languages and lend a helping hand in interpreting it and teaching it to others.

METHODS OF FORECASTING THE WEATHER.

A Lecture delivered by Prof. Dr. J. M. Pernter to the Association for the Advancement of Scientific Knowledge, Vienna, January 14, 1903. Translated from the Vorträge des Vereines zur Verbreitung naturwissenschaftlicher Kenntnisse in Wien. 43d Jahrgang, Heft 14.

Allow me to-day to address you once again on the subject of weather prophets, and this time to bring before you not only one or two kinds of weather forecasting, but to give you a more general survey of all methods at present in use, be they right or wrong, with or without results. I will keep strictly to the title of this lecture and give the prominent place to the methods of forecasting. I shall explain them and subject them to critical analysis, naming at the same time the advocates of each of the various methods; in the technical investigation, we have to do with the value of the methods and not that of the persons. I must, however, at once bring prominently forward the fact that we have at present, unfortunately, no method by which we can forecast the weather with absolute certainty even for one day in advance, to say nothing of longer periods. This is already self-evident from the fact that we are now able to speak of many methods of forecasting, whereas if there were a sure and infallible method, then it would be out of place to speak of the other methods to this society for the advancement of scientific knowledge.

All methods of weather forecasting, not excepting those in use by the central meteorological offices, are based upon observed weather conditions and have, therefore, an empirical foundation. Many of them do not even make the slightest attempt to put their methods on a theoretical basis and content themselves with setting up "weather rules." Even the scientific methods of professional meteorologists have not yet succeeded in deducing a theory capable of determining in advance the changes of the weather as the effect of one or several known causes. Only the advocates of the influence of the moon have ventured solely by means of aprioristic theories to "calculate" the weather for long periods in advance.

There are many widely different methods by which the various classes and kinds of weather prophets carry on the work of weather forecasting. There are those who make use of the behavior of animals to foretell the weather; hunters who recognize the character of the approaching season from the actions of the wild animals; the observers of birds, spiders, crickets, ants, and other animals from whose conduct they judge of the approaching weather. But in addition to this class which utilizes living animals there is another opposing class that prefers to make use of the dead substances of the animal or vegetable kingdoms, such as hairs, strings of instruments, roots and fibers of plants; by means of their expansions or contractions, either with the aid of little weather houses and figures or without them, they recognize the coming weather. Others prefer to consult stones and walls as to the character of the weather to be expected, and turn rather to inorganic nature in order to learn from the "sweating" or dryness of these whether to expect rain or continued fine weather. Thus, as you see, all the kingdoms of nature are drawn upon to furnish prognostics of the weather, and it may depend upon the occupations and predilections of the various persons interested in the coming weather whether they give the preference to one or the other. But I had almost forgotten to mention another class—perhaps the largest—those who are not to be satisfied by any one of the three kingdoms nor even by all three together, and who rely only on

their own bodies for foretelling the weather—assuming, of course, that these have nerves, joints, and corns; sometimes it is the stomach and sometimes even the head that is made use of. I am not joking in the least; on the contrary the persons inclined to this kind of weather forecasting excite my sincere commiseration.

If these classes of weather prophets who undertake to foretell the weather by the sensations of their bodies, by observations of the animal and vegetable kingdoms, and even by the processes of inorganic nature, always rely upon facts which may have a distant connection with the weather, yet, they are still far behind that class which forms its conclusions of the approaching weather from observations of the weather conditions themselves. You are all well acquainted with this latter class of weather prophets; in every community there is at least one person who is especially relied upon, whether he be a farmer, a miller, a teacher, or a pastor of long standing. They look up at the sky, observe the clouds and the direction of their motion, and from these they forecast the weather for the next day, with good results. These local weather prophets rely indeed upon phenomena which have the closest connection with the coming weather. For the weather does not spring like a Deus ex Machina down from a distant cuckoo's nest in the clouds, but is drawn from comparatively near regions, or if you prefer, forms gradually in the place itself. This coming, this formation of the weather is announced by the appearance of the sky, sometimes for a longer, sometimes for a shorter time in advance, and the skill of the weather prophet consists in rightly interpreting, for the near future, the appearance of the sky and the weather conditions. Since it is generally necessary, in order to grasp the weather conditions correctly, to have a clear judgment founded on long experience in observing, together with an accurate eye and, I might almost say, an inborn quickness of perception, therefore, there are, as a rule, only single individuals in every community who enjoy the reputation of being good weather prophets. Certain phenomena, however, are of so typical a nature that they have been reduced to fixed rules and are everywhere expressed in popular language.

Thus every country has its weather signs; if the clouds are increasing, a storm or continuous bad weather is approaching. In every locality there is one direction of cloud motion that betokens bad weather, and another, generally the opposite direction, which portends fine weather, etc. Weather rules relative to the red morning and evening sky have been deduced. The rules that bad weather is expected when in any given locality the summit of a certain mountain is covered with a cap; that a small "watery" halo around the moon indicates rain; that the weather will continue bad if, when the clouds break up, a second light covering of clouds is seen above them; that it will be fine weather if, after rainy weather, according to the locality, a certain wind sets in; that a slow breaking up of the clouds gives promise of fine weather, etc.; all of these rules have been formulated from long-continued and accurate observation and are exceedingly well adapted for local weather forecasts from one day to the next. Experienced observers also know from the color and nature of the clouds whether the prevailing weather, notwithstanding otherwise favorable indications, will continue or will change, and by these delicate distinctions they generally acquire the reputation of being especially good weather prophets.

These observations of weather signs led the way, however, to more far-reaching rules which included the attempt to determine from the weather conditions at a certain season of the year what they would be for a long series of days; or, to determine from the weather of a season, or of a certain day, or a fraction of a day, the conditions of an approaching season. Thus originated the so-called "farmers' rules," among which are some valuable ones based upon good observations extending over a hundred years, but in contrast to these there are, unfortunately, many poor ones for which we are indebted to the superficial and frivolous rules manufactured by speculating calendar makers.

Others, however, went still further and, from observing that the weather of one year resembled that of a former year, concluded that there is a certain regularity in the recurrence of years with similar characteristics, and that they were justified in enunciating the law that almost exactly the same weather returns at intervals of eleven, or of eighteen or nineteen years, so that it would only be necessary to expect in the coming year the weather observed a certain number of years before. It is evident that this would be the simplest method for predicting the weather in any year, day by day or at least week by week, and this is the system followed in the so-called "hundred-year calendar." Unfortunately the facts do not agree with the predictions.

Both the methods above named in general endeavor to keep one free from preconceived ideas as to causes, and base their predictions of the weather only upon earlier observations and experience, often supported by records of the weather actually prevailing, whether made with or without instruments. There are other prophets who have sought for the cause that dominates the weather and weather changes and adopting this when found have made their weather predictions in accordance with the properties, movements, and changes of this accepted cause.

This latter class, somewhat precipitately and without sufficient experience in the principles of observational work, but driven by the innate longing in the human breast to seek for a cause for all matters and supported only by general a priori considerations has sought for the dominating cause of the weather. Thus, from the consideration that the sun dominates everything on the earth Professor Zenger has chosen that as the agent of the weather changes, which he ascribes to the rotation of the sun on its axis. Now, since the time required for a revolution of the sun occupies about twenty-six days, he has chosen one-half of the time of a revolution, that is to say twelve to thirteen days, as the period by which he measures the changes of the weather, and has arranged a weather calendar according to which there is a day of disturbance every twelve to thirteen days. In the interval between the two days of disturbance there is an interval of safety or what he calls "calms." The comparison of the predictions of the "days of disturbance," and "days of calms," with the weather actually occurring is supposed to give the proof of the correctness of the assumption that the semirotation of the sun governs the weather. Up to the present time, however, this has not yet been accomplished, for the attempted demonstration has entirely failed.

The method of weather predictions proposed by Professor Servus is of a similar character; he considers the interior of the earth, and from the fact that the attraction of the earth upon the atmosphere attaches the latter to the earth, he argues that "all the great disturbances in the equilibrium of our atmosphere are caused by changes in the condition of the interior of the earth, which produce disturbances in the power of attraction." You will see at once, without further explanation, that this is not a tenable principle for weather predictions: Servus himself, for the purpose of preparing weather predictions, has been obliged to call in the sun and moon to his aid as causes of the disturbance in the condition of the interior of the earth. In this way his method approaches so nearly to that of Zenger and those of the lunar prophets that we need not treat of it separately.

But Professor Lamprecht has shown us in a most startling manner how far one may be led away by adopting a priori causes for the changes of weather without a sufficient basis of experience. By analysing a series of observations for several

years he has discovered five periods in weather processes, one of $12\frac{1}{9}$ days, one of $12\frac{3}{10}\frac{3}{0}$ days, one of $13\frac{9}{11}$ days, one of $14\frac{3}{4}$ days, and one of $29\frac{3}{7}$ days. Before passing on I must just tell you that one can, according to his method, compute periods of almost any length desired. This is not objectionable; but he now proceeds immediately to find the causes for these periods, which were really only computed and not at all furnished by experience, and, since he sincerely wished it, he found them. We can only be astonished at the boldness of his hypothesis. He assumes the earth to be surrounded by five rings, similar to the rings of Saturn, and that their periods of rotation and temporary relations to one another are the causes of his weather periods. Lamprecht represented to himself the existence of these imaginary rings in such a manner that he immediately endowed the rings with names, giving them successively the following magnificent names: Emperor William ring, Moltke ring, Bismarck ring, Copernicus ring, King Albert ring.

An old and by far the most widespread method of weather prediction is based on the idea, which is I might say universal among mankind,[1] that the heavenly bodies have an influence on everything which takes place on the earth, and particularly upon the weather. The moon is that one which was supposed to more especially influence the weather, although this power was attributed to the planets also, so that each one produces a certain kind of weather, and therefore divides the year into damp, dry, stormy, quiet periods, etc., according as one or the other planet is the "ruler for the year." The moon is credited with being the principal dominator of the changes of the weather. The weather is supposed to change by preference with the moon; therefore the new moon and the full moon especially possess the power of influencing the weather, and one of the most widely spread weather rules is that the weather changes with the new moon and the full moon. However, the first and last quarters are considered of greatest importance by a great many. Especially clever observers of the influence of the moon upon the weather pretend to have also observed the distinctive individual influences of the phases known as octants. In general the opinion is very widespread that the decreasing moon exercises a weak and the increasing moon a strong influence. Thus far the theory of the influence of the moon on the weather is the direct result of the popular belief in the moon, without regard to any scientific basis.

I am not able to state whether the growth of this popular belief was preceded by observations of the weather changes, and is therefore to be regarded as a result of observations (it is not a question here as to whether the latter were defective and inconclusive or not) or whether, on the contrary, the belief in the influence of the heavenly bodies and in that of the one which, after the sun, appears the largest and most striking to mankind, namely, the moon, was the earliest step, and that it was in the light of this belief that observations were first made. At all events the latter is far more probable than the former, and, therefore, I can not put the moon theory of weather predictions in the same category as the methods mentioned in preceding paragraphs. These latter methods were certainly based on observations (we say nothing as to whether the observations were correct or not); but this is not established in regard to the belief in the moon theory: indeed the probability is in favor of the contrary process, namely, the opinion that the moon must influence the weather came first, and observations only came later in order to see if the theory were correct.

This idea is strongly supported by the more recent development of the theory of the influence of the moon upon the weather. This newest and at the present time very prominent phase of this theory did not start by collecting reliable observational data and deducing from these observations the influence of the moon, upon the weather, but first adopted the old belief in the moon and then sought to create for it a scientific basis by means of a priori assumptions and even theoretical mathematical explanations.

With these results, either assumed or computed, the representative of the modernized theory of the moon appears before the public and invites his contemporaries to test his "results" by observation. This process is, as you see, the exact opposite to that of the true empirical method. The empiricist makes observations, observes long and much, and sums up the general results of the observations in certain propositions or "rules," and when it is possible, draws his conclusions as to the cause of the phenomena. The modern moon prophets turn the process upside down. They designate the moon beforehand as the cause of the changes of the weather; from the various positions of the moon with respect to the earth and the sun, with the assistance of the laws of attraction—without any strict investigation as to how far these can possibly be of influence—they compute the attraction exercised by the moon in its separate positions, and say on such and such a day the influence of the moon must have produced such and such a result on the weather. The confirmation of these predictions by the observations should then only show the accuracy of their assumptions and computations. The number of these modern moon prophets is at present large; many of them take into consideration the planets in addition to the moon. The names of the most prominent advocates of these moon theories are known to you. They are as follows: Falb, Ledochowski, Gladbach, Demtschinski, Garigou-Lagrange, A. Poincaré—not the celebrated mathematician—and Digby.

It would be quite erroneous if this method of investigation into the causes of the weather were regarded as incorrect and improper. By this presentation of the subject I wish only to show that the modern moon prophets—and probably also the older ones—have not introduced strictly inductive empirical methods into their belief in the moon, but that this belief was there from the first and that they have made use of the discovery method for its confirmation, since it is on the basis of the moon theory, or, if you prefer, of aprioristic considerations as to the influence of the moon, that they make their weather predictions, and then from the agreement between these they endeavor to deduce the correctness of their assumptions. Against this method as such there is nothing to be said, but it demands the most conscientious, straightforward, logical, and accurate determination of the consequent weather if we wish by this method to arrive at a confirmation or refutation of the propositions advanced as to the influence of the moon. How this is to be managed we have still to learn; meanwhile it is at present only necessary, in this enumeration of the various methods for predicting the weather, to include that one which represents the influence of the moon.

As soon as men began to observe the barometer attentively, they began gradually to recognize that the rising and falling of the barometer had an evident connection with the weather. It was the celebrated burgomaster, Otto von Guericke, of Magdeburg, who first used the barometer as a "weather glass." He applied, even then, to his water barometer the "weather scale" which is at present in such general use, on which the highest reading occurring at any place is designated as "Fine Weather," the lowest reading as "Rain and Wind," etc. The barometer as a weather glass has taken its course throughout the world and is, to-day, used almost universally. After the introduction of the aneroid barometer the "weather scale" was also affixed to that and whoever purchases such an instrument pays particular attention to make sure that the

[1] Astrology seems to have been specially cultivated in Mesopotamia and to have been spread north, south, and west by Sanskrit, Greek, and Arab influences. It is peculiarly Asiatic and European. There is no record of its having had any great influence among the Chinese, Malays, or American Indians. It can, therefore, hardly be spoken of as universal among mankind.—ED.

weather scale is correctly fixed on it. The makers of these instruments must know the mean pressure at the dwelling place of the purchaser; there they place the term "Changeable;" the point where the pressure is about 10 millimeters above the mean is "fine," and at about 20 millimeters above the point designated as "changeable" will be "steady," "fine," or "dry," or the like. At about the same distance below "changeable" is placed "rain" and storm."

Whoever has provided himself with an instrument of this kind believes himself to be the possessor of a self-registering weather prophet and is generally highly indignant if it rains when his barometer stands at fine, or astonished if it is fine weather when the barometer says rain. Since these erroneous indications are not unusual with the barometer, therefore faith in it as an indicator of the weather is very much diminished and is only maintained at all, on the one hand, by the fact that the barometer frequently "indicates correctly" and, on the other hand, by force of habit. Frequently, however, one has taken refuge in another instrument, namely, the hygrometer. This instrument shows only the amount of moisture actually prevailing in the air, in the same way that the barometer indicates the actually prevailing pressure. As the pressure and the moisture are both connected with the weather, the hygrometer may be used as a weather prophet in the same way as the barometer, although that is not its real vocation. If the hygrometer shows a high degree of moisture, that only indicates that the air is just then very moist, and this generally happens only when the weather is already bad. However, it happens sometimes that the moisture in the air increases while the weather is still fine, so that the hygrometer then indicates approaching bad weather. In the same way, the hygrometer will generally indicate dryness when the weather is fine; it will sometimes, however, when the weather is not yet fine, point to decreasing moisture, and thereby foretell approaching drier and finer weather. The best of these hygrometers are made of human hairs, divested of grease, which have the property of being expanded by dampness and contracted by dryness in a most admirable manner. This property of varying its dimensions with the changing moisture is also possessed by other animal and vegetable substances. There are a number of weather indicators of this kind, among which the little house with the little man and woman, in which the man goes out in bad weather and the woman in fine weather, is probably the best known.

The discredit into which the hygrometer, as a weather prophet, has often fallen, is as easily understood, as in the case of the barometer. Its duty is only to show the moisture actually prevailing at its locality, and this knowledge does not enable one to make determinations of the approaching weather any more accurately than does a knowledge of the pressure at any place.

A new, and we must at once say, a truly empirical method of weather prediction is that at present in use by all the official central meteorological establishments in the world. This method has gradually and slowly developed according to the exact rules of investigation in scientific practical meteorology, and is still far from having reached perfection. It has developed entirely, without any addition of an aprori nature, out of the observations of the weather processes, and is, therefore, based entirely upon well established observational data. The most fundamental of these facts is that the weather is associated with the distribution of atmospheric pressure. It has been recognized more and more clearly by experience that the weather is determined, not by pressure as shown by the barometer at the place of observation, but by the barometric conditions that prevail over vast regions—for instance, those distributed over the whole of Europe. Therefore, one must chart and study the distribution of atmospheric pressure over the whole of Europe if one wishes to understand the weather actually prevailing.

It was necessary, first of all, to determine by extended observations, made as nearly simultaneous as possible, the distribution of atmospheric pressure for a definite hour, in order to perceive to what kind of weather this distribution of atmospheric pressure corresponded. It was by this means demonstrated that there is an extraordinarily great variety of forms of atmospheric pressure distribution; that these, however, can be classified into a certain number of types by having regard to the form as well as to the weather conditions given in these forms. Allow me to illustrate, by some of the cases before us on these charts, the manner in which this study of the relation between the distribution of atmospheric pressure and the weather has proceeded, a work that is at present being still further carried on.

Figs. 1 to 8 present the principal types[2] of the distribution of atmospheric pressure over Europe. They have been chosen in order that we may observe those types which influence the weather in Austria. Here we find the distribution of atmospheric pressure grouped, on the one hand, according to the location of high and low pressures over various regions of Europe, and on the other hand, according to the forms of the isobars. These are not average or ideal charts, but each one reproduces the distribution of pressure actually observed from 7 to 8 o'clock in the morning of a certain day. We have here before us the following types:

(*a*) Weather map for September 22, 1895. Region of high pressure central over Europe, gradually diminishing in all directions.

(*b*) Weather map for January 3, 1894. Region of high pressure over the north of Europe, region of low pressure over the Mediterranean Sea.

(*c*) Weather map for February 23, 1892. Region of high pressure in the northeast, or northern Russia, region of low pressure over the Atlantic Ocean in the west.

(*d*) Weather map for January 10, 1899. Region of high pressure in the southwest over the Balkan Peninsula, region of low pressure in the northwest.

(*e*) Weather map for November 26, 1888. Region of high pressure in the south over the Mediterranean Sea, region of low pressure over the north of Europe.

(*f*) Weather map for January 30, 1892. Region of high pressure in the southwest over Spain, region of low pressure over the north and east.

(*g*) Weather map for October 17, 1895. Region of high pressure in the northwest over England, region of low pressure in the east and southeast.

(*h*) Weather map for May 16, 1895. Region of high pressure in the west and east, region of low pressure over the whole of middle Europe from the north to the south.

These selected charts are representatives of the most important styles or types of the distribution of atmospheric pressure upon which our weather depends. The thorough and persevering study of the weather that prevails on the occurrence of each type has led to the definite and certain recognition of the following theorems:

1. The weather, in all its details, depends upon the distribution of atmospheric pressure, and the same weather always corresponds to the same location relative to this distribution.

2. The weather of any place is, therefore, determined by its position in, and relation to, the various styles of pressure distribution.

3. If we succeed in knowing in advance what distribution of atmospheric pressure will prevail on a certain day, or on a series of successive days or a longer season, then the weather of the day, or of the period of time, is thereby determined in advance.

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[2]The maps are omitted in this translation, as analogous American types are to be easily found.—ED.

4. The modifications introduced by reason of geographical conditions, the configuration of the ground, as for example, the location of a place in the Alps, etc., are constant for the location in each style of pressure distribution.

By means of these theorems, which were deduced from exact observations, the foundation was laid for a careful method of weather prediction. Two things were now necessary: (*a*) The perfecting of our knowledge of the typical distributions of atmospheric pressure and of the details of the weather attending them; (*b*) the deduction of the rules, according to which one form of distribution of pressure either remains stationary, or moves over Europe, or changes into another form, or is pushed aside by some other type.

It is in the nature of things that the first task is more easily accomplished than the second. The present state of the art of weather prediction in our central meteorological institutes corresponds to this condition of affairs. The details of the weather conditions within the various styles of pressure distribution are, on the whole, quite well known: however, there remains much to be done in this direction, and it is now one of the most important duties of meteorology to most thoroughly investigate, in all directions and details, the distribution of the weather according to the forms of pressure distribution. The knowledge of the weather conditions for every place and for every type of pressure distribution offers the only entirely satisfactory empirical basis for weather predictions; moreover, it is by this knowledge alone that we can hope at some time to discover the fundamental laws of the changes in the weather. This knowledge, however, does not lead us immediately to a prediction of the approaching weather, but only teaches us to know the weather of one particular place when the distribution of pressure is known. In order to be able to predict the weather, we must know one thing more: we must know in advance what distribution of atmospheric pressure will prevail at the time for which we are predicting the weather. This foreknowledge of the pressure distribution is the starting point upon which the whole weather forecast depends. If this foreknowledge of the future distribution of atmospheric pressure is impossible, then weather prediction is impossible; if we can foretell it approximately, then a weather prediction of greater or less probability is possible, and we shall be able to make a larger number of correct than of incorrect predictions; if the distribution of atmospheric pressure can be known in advance with certainty, then we shall be able to make weather predictions with certainty.

Now, how do we stand as to the question of certainty in foreseeing the approaching distribution of atmospheric pressure? If we knew the laws according to which one distribution of atmospheric pressure changes over into another, or according to which it moves across Europe, as well as the laws that cause one distribution of atmospheric pressure to continue stationary or suddenly break up and another one result from from it, then the problem could be solved and future weather could be predicted with entire certainty. We should proceed with mathematical accuracy in the prediction of weather, and be able to attain the correctness of the astronomers in their predictions of celestial planetary motions and phenomena. This of course, is the ultimate aim of meteorological science, but we are at present so far removed from it that we have may well founded doubts as to whether this object will ever be attained. Up to the present time we are only able to deduce from the experience hitherto acquired a few empirical laws of limited applicability, according to which the types of distribution of atmospheric pressure remain stationary, change, or transform themselves entirely, or perhaps move away over the earth; even this limited empirical knowledge relates almost entirely to the change from one day to the next. Since these empirical laws as to the changes in the distribution of atmospheric pressure are so defective the difficulty of foreseeing the approaching distribution of pressure is correspondingly great, and the prediction of the weather even for the next day is proportionately unreliable. Since we have to do only with theorems founded entirely upon experience, the persons best qualified to make the predictions are those who through long years of practise have collected the most theorems as to the variations in the forms of pressure distribution, and have also learned by practise the many modifications to which these theorems are subject. In the forecasts for the next day men of much experience attain to more than 80 verifications in a total of 100 predictions; but the prediction of the distribution of pressure for more than one day in advance has such a low probability that in a forecast of the weather for several days in advance we must expect more failures than results.

You will say: "It is despairingly little that we have to expect from scientific weather predictions, and hence it is not to be wondered at that the public generally clamors for methods that promise more." It is easy to promise, but one's promise must be kept, and that is difficult. It would also be easy for scientific meteorologists to make the same promises and boastings as the other weather phophets, but they would then cease to be called scientific. And of what use is it to cling to those weather prophets who certainly promise a great deal, but finally leave you in the lurch? Of the popular methods of predicting the weather above enumerated, none accomplish nearly as much as is accomplished at present by the scientific method; indeed, very often they accomplish nothing beyond the noise they make in praising themselves. However, before I begin to criticize the various methods, I will briefly lay before you the processes adopted in weather prediction at the central meteorological stations. You know that at our Central Office in Vienna, for example, telegrams arrive every morning from more than 140 places over the whole of Europe; these telegrams contain the observations made that morning of pressure, temperature, moisture, precipitation, and wind. According to these telegrams the chart of the distribution of atmospheric pressure is drawn as it prevailed over Europe that morning; and from this particular style of distribution of atmospheric pressure in conjunction with that which prevailed on the preceding day, and by making use of the above-mentioned empirical laws governing the changes in the forms of the pressure areas, a tracing is made of the probable areas of atmospheric pressure for the next day. When this sketch is completed, then the predictions for the various portions of the kingdom are made upon the basis of our knowledge of the weather conditions at different points of each area of atmospheric pressure. Thus, the primary difficulty consists in forming a correct conception of the pressure distribution for the next day, based on that prevailing on the morning of the day in question, and at the same time a clear idea as to the velocity with which the changes will proceed. In order to facilitate this difficult task the Central Office receives immediately before the making of the forecast, which takes place at 1:30 p. m., a short telegram from twelve selected stations in Austria-Hungary, giving the latest information as to changes in temperature, pressure, and cloudiness that have occurred at these stations since the morning observation. From this last item we can perceive with more certainty whether we have formed a correct idea as to the distribution of atmospheric pressure for the next day or not and, therefore, whether to retain or modify the forecast. It is only after the data of the midday telegrams have been made use of that the definitive forecast is made. At 1:45 p. m. the weather report goes to the printer and the corresponding telegrams are sent to those who have subscribed for the daily telegraphic forecasts.

The results of this system of honest weather forecasts are indeed modest, but are such as to show a real and striking progress in weather predictions as compared with other methods. Of course even this earnest scientific method allows

us only to consider the general characteristics of the weather as, for example, "fine," "windy," "mild," "fine and cold," "cloudy," "rainy," "warm," etc., as the object of the weather forecast. This method would immediately supplant all others if it would undertake to foretell the duration and amount of precipitation, the degree of the thermometer, the exact force of the wind, etc. However, we may at present be very well satisfied if the general character of the weather is predicted for us. Unfortunately, even the scientific method can give us no positive certainty, since even by confining itself to these general characteristics it can at present offer only a little above 80 per cent of verifications of the weather.

In this state of the case it is self-evident that our efforts are to be guided in the direction of those studies that will lead us to an ever increasing accuracy in forecasting. These studies of course relate (1) to more and more thorough investigations of the weather conditions at every point and in every phase of the distribution of atmospheric pressure; (2) to the discovery of signs by which to form a judgment (*a*) as to the rapidity and paths with which each type of pressure distribution moves over Europe; (*b*) into what other forms a given type of distribution transforms itself and the rapidity of such change; (*c*) what changes in the weather attend the various modifications of one and the same type of atmospheric pressure distribution. With the increase of our knowledge on these points the weather predictions will also become more and more accurate; however, it is very doubtful whether it will ever be possible for us to invariably attain absolute accuracy even for one day in advance. Every increase in the percentage of verifications is, however, of the greatest value, especially to national economics.

Now, as a matter of course, the meteorologists are looking everywhere in order to take advantage of everything which may be of assistance to them in this matter. In the first place there are the many good weather rules that have been deduced from the experience of many hundreds of years. But the greatest number and most valuable of these weather rules are only applicable to local weather predictions, whereas the central meteorological institutes must make their predictions for very distant countries also, as for example, Austria for Dalmatia, Vorarlberg, Bukowina, etc.

Those weather rules, however, which relate to the weather conditions of certain definite dates and which are generally looked upon as farmers' rules are sometimes of great assistance in making forecasts. Thus, we know that on certain dates of the year there has for centuries been a tendency to a certain kind of weather; for example, to rainy weather. Therefore, if at such periods the distribution of atmospheric pressure is of such a form that it may easily change to a type corresponding to the weather indicated by the farmers' rules, then we may be tolerably certain that we must forecast wet weather. But, on the other hand, if at some such period the distribution of pressure is of such a character as would ordinarily justify us in hoping for a change of weather, still we know that this change is not likely to occur, because there is a continued tendency at this period to wet weather and a change of weather is not to be looked for. Such aid as this from farmers' rules is, however, of moderate value and rarely available. But it is quite otherwise, in the opinion of the believers in the moon, when we consider the support that the weather predictions might derive from hypotheses that attribute to the moon and the rest of the heavenly bodies a decided influence on the weather. I will express myself more in detail on this subject.

First and foremost, I must insist most strongly on the fact that professional meteorologists themselves have always recognized and do recognize one influence of one heavenly body as most decisive and the sole cause of the weather on our earth, viz, the heating of the earth and of its atmosphere by the sun. The sun regulates our weather; it gives rise to winter and summer; by evaporation it raises the aqueous vapor into the air, and this vapor, by cooling, produces clouds and rain, snow, storms, and hail; it is the primary cause of the differences in atmospheric pressure, and in this way produces the winds.

This heating influence of the sun, as also its modifications by cloudiness, by the wind, by the change from day to night or from winter to summer, and by the properties of the earth's surface, which, consisting as it does of water and of land either covered with vegetation or barren and bald, has varying capacities for absorbing the sun's heat—this influence of the heat of the sun has been established with the most absolute certainty by the most exact observations. It has been demonstrated to be so much more important than any other cause, if any such exists, that up to the present time it has not been possible to recognize any other cause with certainty, in spite of the fact that the professional meteorologists, and singularly enough they only, have instituted extensive and most thoroughly exact investigations in order to discover such other influences, in case there are any, and to determine their value. And what has been the result of these extraordinarily laborious and wearisome investigations? Before I answer this question I must call your attention to the fact that not one of the representatives of the theory of the influence of the moon, or of any other cosmical influence, has undertaken to give an unobjectionable, rigorous demonstration of such an influence. These gentlemen content themselves with the inventive method and apply it in a very singular manner. They make their predictions for certain days and always call attention to the cases when they are successful, but never trouble themselves about the failures. Now I beg you to observe that in every game of chance where there are but two alternatives there must occur 50 verifications out of every 100 guesses, when a great number of guesses are made and it is all pure chance. The time at which the game of chance is played, or the time when the guess is made is absolutely without any influence whatever upon the result. So, also, the drawing out of an even or uneven number of balls could have no influence upon the weather even if it should occur to some one always to predict fine weather when he drew an even number and bad weather when he drew an uneven one. If, therefore, one should make use of the above mentioned inventive methods, he should carefully record all the cases, the failures as well as the verifications. And then, even if every second case is a success—that is to say, even if he obtains 50 per cent of verifications—he will know that the theorem or assumption made use of as the basis of the predictions really has no causal connection with the weather. Only when more than 50 per cent of verifications are attained can the argument favor the assumption, and so much the more in proportion as the verifications exceed 50 per cent.

This exact method, the only one for testing their hypotheses as to the cosmical influences on the weather, is the one that has never been applied; in fact it has often been distinctly rejected by those who maintain the existence of these influences; and yet those who make assertions should prove them. It was the professional meteorologists themselves who undertook the accurate examination of all the various cosmical hypotheses, and particularly that of the influence of the moon, and it was they who found a slight influence of the moon on storms, thunderstorms, the direction of the wind, atmospheric pressure, etc. Now, do you say, "I told you so?" Well, first of all observe—and I can not insist upon it too strongly—that it is the professional meteorologists, and they alone, who have made these investigations which point to a slight influence of the moon. Next, I must direct your attention to that little word "slight." The influence thus discovered by them is indeed so small that we can not even state with certainty whether it really does exist at all; or whether, perhaps, it was only perceptible in these investigations because the period of time included in them is still too short to furnish us with an

unexceptionable result. However, let us assume that this slight influence really does exist, and let us examine the amount of this influence a little more closely. Its magnitude is expressed by the percentages of the favorable cases. We will, however, for once greatly exaggerate and assume that these favorable cases amount to a surplus of 5 per cent. That is to say that in 100 cases 55 succeed and 45 fail. Now, if you use such lunar rules for weather predictions, what does it advantage you in isolated, single cases? For instance, you are in doubt as to whether the rain is to be expected or not; the influence of the moon indicates rain with a weight of 0.05. In spite of this small weight, if now you forecast bad weather, you will, if 100 such cases occur, have a failure in 45 cases. Had you paid no attention to the influence of the moon, you would possibly have had 50 failures. Thus, in this case of 5 per cent of surplus, that would be the whole effect of your consideration of the moon's influence. But we have in fact assumed an exaggerated case, and the real influence of the moon is in every case less than one-half of this, if indeed it really exists at all.

You may rest assured that the professional meteorologists accept, nay even seek for, everything that can give them any assistance whatever in their weather predictions. By constant investigation and study we may hope to advance step by step, and per cent by per cent. Every single per cent of agreement that is gained is an important advance and success.

KITE FLYING IN THE TROPICS.

By OLIVER L. FASSIG, dated Baltimore, Md., December 25, 1903.

On June 1, 1903, an expedition under the auspices of the Geographical Society of Baltimore, directed by Dr. George B. Shattuck, Secretary to the Society, left Baltimore on the two-masted schooner *Wm. H. Van Name* for the Bahama Islands. The purpose of the expedition was to make a scientific survey of the islands along the lines of geology, physiography, botany, climatology, terrestrial magnetism, marine life, and tropical diseases. The scientific staff, comprising 25 members, was selected largely from men at one time or another connected with the Johns Hopkins University and from representatives of several of the scientific departments of the United States Government.

Included in the equipment for a study of the climatological conditions of the islands was a complete outfit for investigating, on a small scale, the conditions of the upper atmosphere, loaned to the director of the expedition by the Chief of the Weather Bureau. This outfit consisted of one medium-sized and one large box kite, two meteorographs, a hand reel with 15,000 feet of steel piano wire, and a nephoscope for altitude measurements. In addition, the instrumental equipment included a Richard barograph, a thermograph, and a hygrograph, a sling psychrometer, a rain gage, and a rain recorder, the property of the Maryland State Weather Service. Provision was also made for observations of ocean surface temperatures from Baltimore to Nassau and return, for tide observations, and for a magnetic survey of the islands by the writer, the results of which will be published later. The present report is confined to a discussion of the results of kite flying at Nassau, the principal town of the Bahama Islands.

Head winds and rough weather caused considerable delay and inconvenience on the outward voyage, and the expedition did not reach Nassau until the 17th of June. Through the courtesy of Mr. Flagler, the use of the grounds and clubhouse connected with the Colonial Hotel was kindly granted for the kite experiments. These grounds were by far the most suitable place to be found in the vicinity of Nassau for the purpose, being one of the few open stretches of field upon the entire island. Situated west of the town of Nassau, along the northern coast of the island and just below the ruins of old Fort Charlotte, the field afforded a free sweep of the air in the direction of the prevailing easterly winds of these latitudes. The Island of New Providence, upon which Nassau is situated, is a small island, measuring less than 20 miles from east to west and about 7 or 8 miles from north to south at its widest point. It lies about 150 miles to the east of the southern point of Florida, in latitude 25° north, longitude 77° 30′ west, along the northern edge of the trades.

Several days were spent in unpacking and mounting the meteorological, magnetic, and tide instruments, and the kites, and in waiting for favorable winds. It was not until the 27th of June that the wind seemed of sufficient strength to warrant an attempt to raise a kite. At this season of the year winds above 10 miles per hour can not be counted on daily, excepting for short periods. Beginning at sunrise with a breeze of 5 or 6 miles from the east-southeast, the strength increased by noon to 8 or 9 miles, with occasional higher velocities, but seldom exceeded 15 miles per hour.

To one accustomed to the rapid and extreme fluctuations of temperate zone weather, the tropical conditions appear monotonously uniform; clear skies with intense sunshine, a few patches of loosely formed cumulus clouds, an occasional shower of short duration, a small range of the thermometer, generally, at this season, keeping within the limits of 80° and 90°, these are conditions which may repeat themselves day after day for long periods. Though the direct sunshine is intense, the atmosphere is not excessively oppressive, being moderately dry, and seldom stagnant. So far as personal comfort is concerned, these conditions are less trying than the warm, muggy days of the coastal plain of the Middle Atlantic States. In these islands there is generally a sufficient breeze for comfort when not exposed to the direct rays of the sun; from the warm moist and stagnant atmosphere of the Middle States there is often no escape, even under the shelter of roof or tree.

A preliminary flight was made on June 27, between 11 a. m. and 1 p. m., using the smaller 7-foot kite. The wind was east-south-east, and blowing with a velocity of about 10 miles per hour. No effort was made to reach any considerable height, the main purpose being to test the kite and apparatus. The maximum elevation was slightly over 1000 feet.

In all of the experiments conducted at Nassau, the kite meteorograph was checked by means of an aneroid barometer and a sling psychrometer at the surface just before the kite was raised, and at short intervals until the close of the flight. In addition, the barograph, thermograph, and hygrograph were installed in the Nassau Cable Office, about three-fourths of a mile distant, by the courtesy of Mr. P. H. Burns, Superintendent of the Bahama Cable; these instruments in turn were checked frequently by means of eye observations of the thermometers and mercurial barometer at the Cable Office.

On July 1 the kite was raised at 10 a. m. and not lowered until nearly 5 p. m. The wind was east-southeast, with a velocity of 15 miles, until 1 p. m., when the velocity fell to 11 miles, which was maintained until the end of the flight. The day was marked by an unusual amount of cloudiness, varying between five and seven tenths, mostly cumulus, with a few alto-cumulus. A light scud occasionally passed under the kite. On several occasions the kite was entirely obscured, being sometimes in the passing cloud, and sometimes above it. The greatest elevation attained was about 2600 feet at 12:23 p. m., with a temperature at the kite of 69°, and a surface temperature of 83°. The atmospheric pressure, as registered on the kite meteorograph, was 27.60 inches, and at the surface 30.03 inches. It was with considerable difficulty that the kite was maintained at the higher elevations. The tracings of the kite meteorograph, (see figs. 1, 2, 3), show constant fluctuations, doubtless largely due to frequent reeling and unreeling in attempts to increase the altitude of the kite, but in a measure also to be attributed to variation in the strength of the wind.

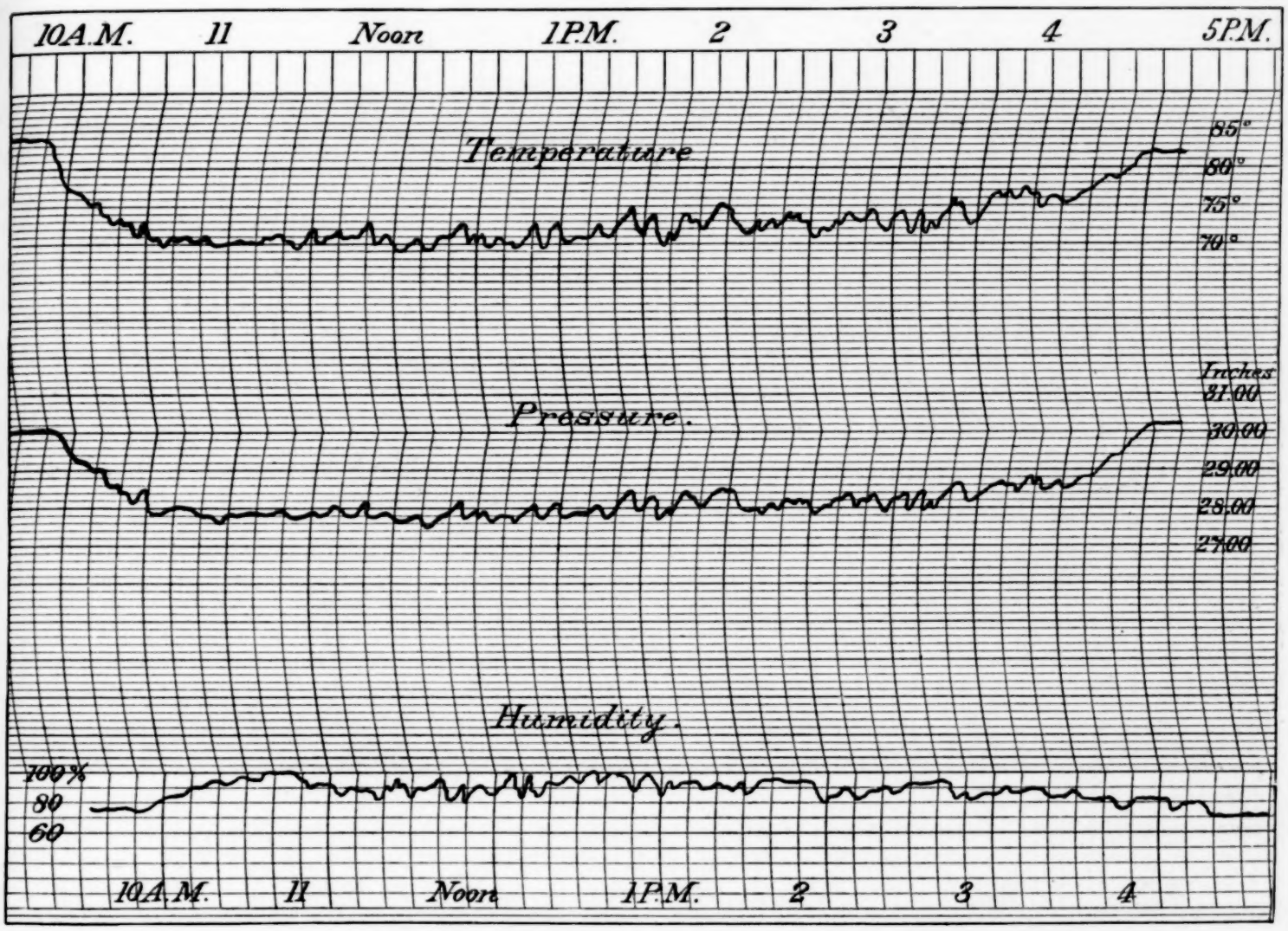

FIG. 1.—Nassau, Bahama Islands, July 1, 1903, 9 a. m. to 5 p. m.

On the following day, July 2, the larger 9-foot kite was launched. The wind was from the east-southeast, and unsteady, with a velocity varying between 8 and 10 miles per hour; the sky was from three to four tenths clouded. Not much was to be expected under these conditions. The greatest elevation slightly exceeded 2500 feet. The kite was raised shortly after 3 p. m., and lowered a little before 6 p. m. The lowest temperature recorded at the kite was 70°, with 85° at the surface; the pressure fell from 30.03 inches at the surface to 27.60 inches at the highest level. The same irregularities in the meteorograph tracings are to be found in the records of this ascent as were noted in the previous ascent. In fact this is a characteristic of all of the tracings, which would seem to point to a rapid falling off in wind velocity above a moderate elevation.

The next ascent was attempted late in the afternoon of July 3, between 5 and 8 p. m. A good strong wind was blowing from the east-southeast, the weather conditions were unsettled, the cloudiness varying from five to seven tenths cumulus and cumulo-nimbus. A squall arose about 6:30 p. m., with a short shower of rain, during which my colleague and myself sought shelter in the clubhouse. The rain and squall lasted from ten to fifteen minutes. The kite wire was carefully grounded, but small discharges of atmospheric electricity were several times felt. We had no facilities for measuring the potential, but the shocks experienced now and then on accidental contact with the wire were not severe, even on the approach of the squall. The kite reached an elevation of nearly 4000 feet, and was maintained at a high elevation for fully two hours without much manipulation of the reel. The kite behaved well from ascent to landing, and an interesting and valuable record was looked for; but to our dismay on examining the meteorograph it was found that the clock had stopped within fifteen minutes after the beginning of the ascent. Save for the maximum and minimum points of pressure, temperature, and humidity, and the altitude observations, there was no record of one of the most interesting of the 6 ascents made during our stay at Nassau. The lowest temperature recorded was 65°, with a surface temperature of 78°; the lowest pressure was was 26.30 inches, with 30.03 inches at the surface.

On the day preceding our departure from Nassau, namely, on July 6, we determined to try the experiment of flying one of our kites from the deck of a moving vessel. The practicability of this method had already been fully demonstrated by Mr. Rotch, Director of the Blue Hill Observatory, near Boston, and by others who followed his initiative, in the North Atlantic waters. We hoped by this method of artificially "raising a breeze" to attain a higher altitude than we had reached in the light land winds, and at the same time counted upon adding to our knowledge of the temperature and humidity conditions over the ocean in these latitudes. There was very little material to select from in the way of steam locomotion, wind being the motive power for practically all the water craft in this vicinity. The choice lay between a large and powerful

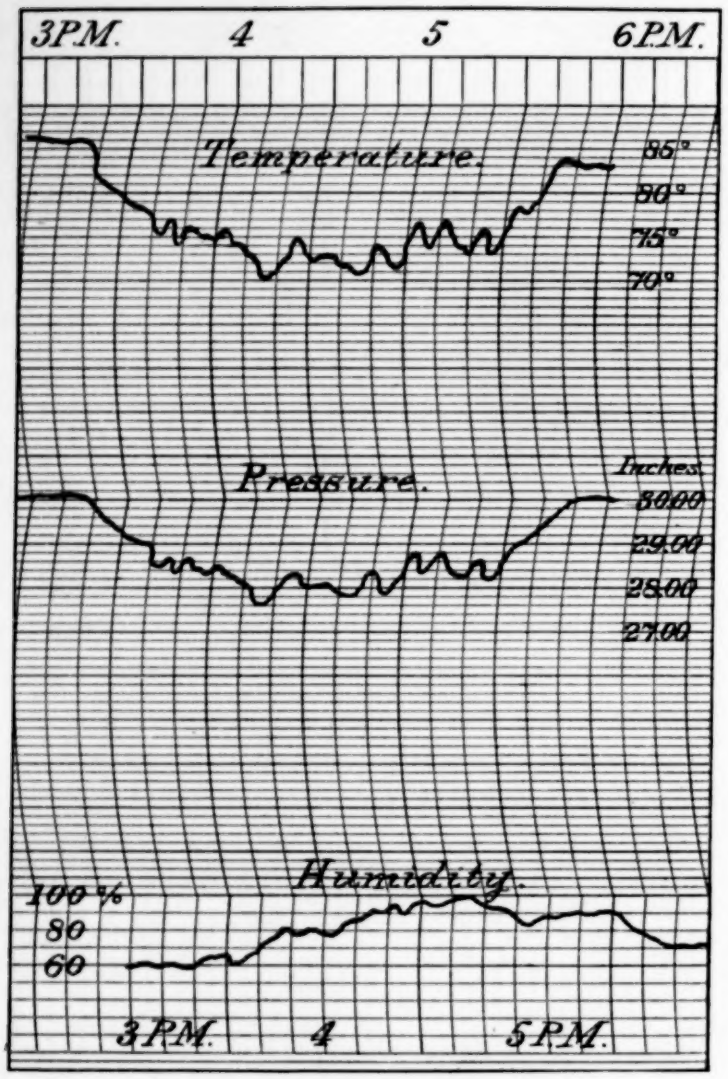

FIG. 2.—Nassau, Bahama Islands, July 2, 1903, 3 to 6 p. m.

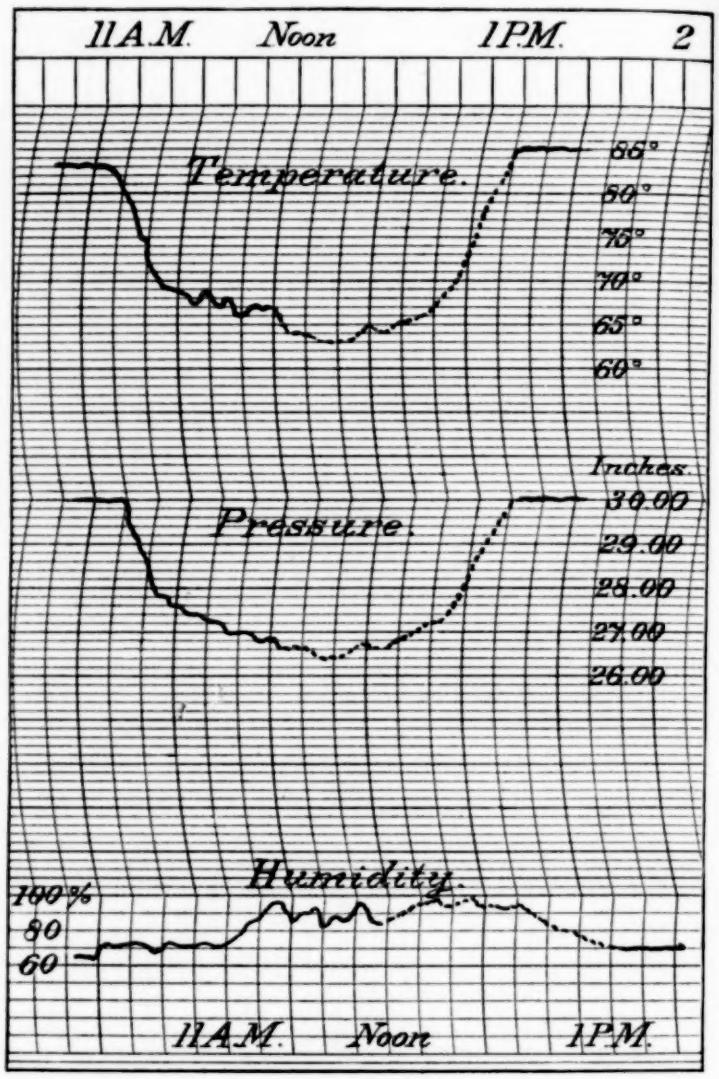

FIG. 3.—Nassau, Bahama Islands, on board the steam launch *Alicia*, July 6, 1903, 11 a. m. to 1 p. m.

steam tug belonging to the company running the regular line of steamers between New York, Nassau, and Havana, but for which an exorbitant charge was demanded, and a small steam launch used for conveying passengers across the channel to a pleasure resort on Hog Island. The smaller vessel was chosen. At 11 a. m. we left the harbor of Nassau on the *Alicia* with the larger of the two kites and the complete outfit. The party accompanying me comprised in addition to the crew of three men, my colleague, Mr. J. E. Routh, who took charge of the nephoscope for the altitude observations, Rev. Mr. Lamont, who acted as recorder, and two natives at the reel. Leaving the channel we steamed out to the north of Hog Island, a long and narrow strip of land lying to the north of the Island of New Providence. Going a mile or two beyond land, we steamed into the wind with a velocity of about 5 to 6 knots an hour. The boat was small and somewhat top-heavy, and there was a considerable ground swell; between the rolling and pitching of the boat and the resulting physiological effects it was with difficulty that we kept ourselves and the reel right side up. Barring a slight delay caused by the snapping, at the moment of ascent, of the small steel safety line attached to the kite, which had to be replaced by a piece of twine, there were no hitches or accidents. The kite rose swiftly and steadily to an elevation of about 4000 feet. With a vessel of greater speed we could doubtless have reached a higher elevation. The surface wind was about 12 miles per hour; to this we added about 5 miles, the speed of our launch. It seems doubtful from our experience during 5 ascents, whether it would be possible greatly to exceed this limit at this season of the year without the aid of an artificial wind, even by means of additional kites. There is apparently a diminution of wind velocity above the elevation of about 4000 feet, in this respect differing from the conditions in the temperate latitudes, where the velocity steadily increases up to the limits thus far attained. This supposition is also borne out by observations of the few upper clouds seen during our stay of five or six weeks in these latitudes. A few clouds of the upper layer were observed, but their slight northward motion was to be detected only after the most careful observations by means of the nephoscope.

The lowest temperature recorded during the ascent of the 6th was 63°, with a surface temperature of 83°; the lowest barometric pressure was 26.40 inches, with a surface reading of 30.05 inches. The humidity ranged from 73 per cent at the surface to 98 per cent. A portion of the record was lost owing to the stopping of the clock a few minutes before the highest elevation was reached, but practically all the record during the ascending branch of the curve was intact. The kite left the boat at 11:10 a. m., reached its greatest elevation at 12:20 p. m., and was lowered at 1:12 p. m. The surface wind was east-southeast throughout, as during all preceeding flights. The kite varied but little in azimuth from that of the surface wind, however, there was always a slight change to a more southerly direction of the wind in the region of the kite.

The east-southeast wind carried the kite beyond the limits of the island in all but the first ascent. In the subsequent higher elevations the kite was always a considerable distance beyond the coast line over the sea. In view of this fact and the small size of the island, all of the observations may be regarded practically as ocean conditions, excepting those recorded within the first two or three hundred feet from the surface.

TEMPERATURE RESULTS.

The average temperature conditions from the surface to an elevation of approximately 4000 feet are presented in tabular form, and charted in figs. 4 and 5. Observations on the each 500 feet of elevation. The actual decrease in each 500 feet, the rate of decrease per 1000 feet, and the number of feet of elevation causing a decrease of 1° F. are shown in the following table:

Temperature decrease. Average of four ascents and seventy observations.

	500	1000	1500	2000	2500	3000	3500	4000	Mean.
Departure from surface temperature, degrees	5	7	9	11	13	16	18	20	
Rate of decrease per 1000 feet, degrees	10.0	7.0	6.0	5.5	5.2	5.2	5.1	5.1	6.1
Number of feet per 1° decrease in temperature	100	143	167	182	192	192	196	196	164

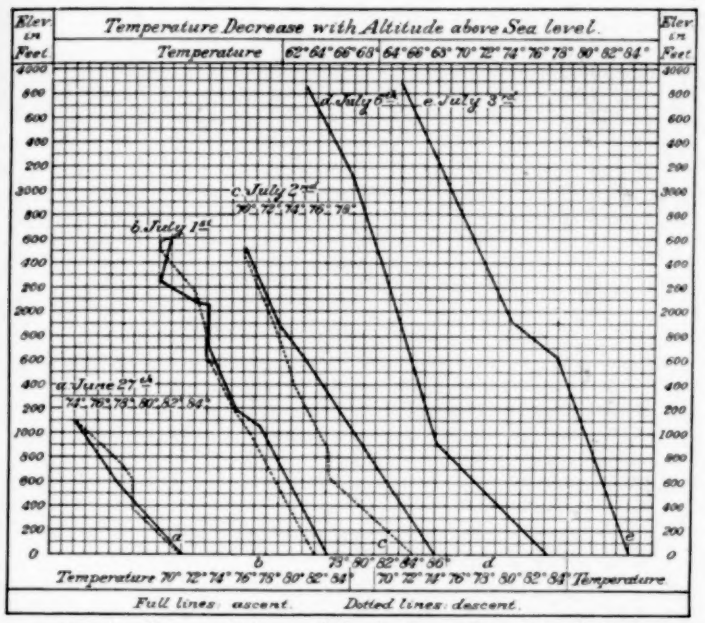
Temperature Decrease with Altitude above Sea level.
Elev. in Feet
Temperature 62° 64° 66° 68° 64° 66° 68° 70° 72° 74° 76° 78° 80° 82° 84°
a June 27th
b July 1st
c July 2nd
d July 6th
e July 3rd
Temperature 70° 72° 74° 76° 78° 80° 82° 84°
Full lines: ascent. Dotted lines: descent.

FIG. 4.—Nassau Bahama Islands, June 27 to July 6, 1903.

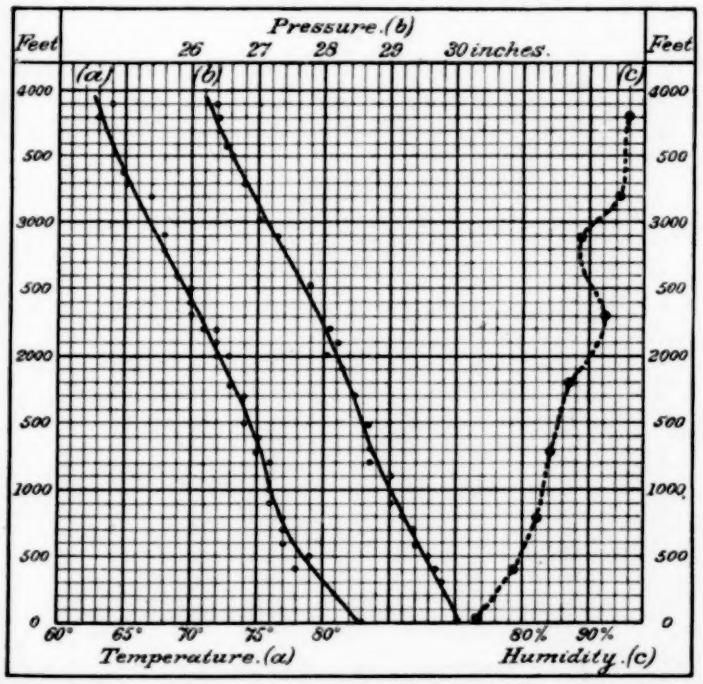

FIG. 5.—Nassau, Bahama Islands, June 27, July 1, 2, 6, 1903. Average condition during four ascents.

nephoscope for angular elevation of the kite, and readings of the dial on the reel for length of wire out, were made every five or ten minutes and sometimes more frequently. From these records and from the tracings of the kite meteorograph, averages were computed and plotted for each 100 feet and

Comparing these results with those obtained at other points under the auspices of the Weather Bureau in the summer of 1898 we find a close agreement. Practically all of the Nassau experiments were conducted in the afternoon. Taking from Bulletin F, of the Weather Bureau, the results of the Washington, D. C., afternoon observations and the mean of the afternoon observations at 17 localities in the United States, and placing them alongside the Nassau observations, the rate of decrease is seen to be almost identical:

Comparative rate of decrease in temperature per 1000 feet.

Elevation in feet.	Washington p. m.	Mean of 17 localities in the United States, p. m.	Nassau, p. m.
	°	°	°
500	...	...	10.0
1000	8.1	7.5	7.0
1500	6.5	6.4	6.0
2000	5.8	6.0	5.5
2500	...	...	5.2
3000	5.5	5.5	5.2
3500	...	...	5.1
4000	4.9	4.9	5.1
Mean	6.2	6.1	6.1

The rate of decrease in temperature computed from averages for each 100 feet is also shown in fig. 5 *(a)*.

DECREASE IN PRESSURE.

As the altitude of the meteoragraph is determined trigonometrically we may compute the average rate of decrease in pressure during 4 flights as shown in the following table, which also shows the number of observations employed and the average temperature of the air in each column of 1000 feet:

Rate of decrease in pressure.

Altitude.	Number of observations.	Average temperature.	Fall of 0.1 inch.
Feet.		°	*Per feet.*
0–1000	16	80.4	95
1000–2000	25	78.3	103
2000–3000	26	69.8	109
3000–4000	7	64.6	105
Means ...		73.3	103

In fig. 5 *(b)* the rate of decrease in pressure is shown graphically. The plotted observations for which the curve is drawn are averages for each successive 100 feet. The total number of observations employed in the construction of the curve is about 75.

RELATIVE HUMIDITY.

Observations of relative humidity at the surface were obtained by means of a Richard hygrograph, checked by direct determinations of humidity by means of a sling psychrometer. The readings derived from the kite hygrograph tracings were averaged for each 100 feet of elevation, and these averages in turn grouped in order to obtain average values for each successive column of 500 feet. In the following table these value are reproduced; the average humidities are also shown graphically in curve *(c)* of fig. 5:

Increase of relative humidity; average of four ascents.

Elevation.	Number of observations.	Relative humidity.	Elevation.	Number of observations.	Relative humidity.
Feet.		*Per cent.*	*Feet.*		*Per cent.*
Surface.	10	73	2500–3000	9	89
0–500	5	79	3000–3500	1	95
500–1000	12	82	3500–4000	2	96
1000–1500	15	84			
1500–2000	16	87		88	86.3
2000–2500	18	93			

As will be seen by inspection of the percentages of relative humidity, there is a steady increase from the surface to the highest elevations reached, namely 4000 feet, excepting the layer between 2500 feet and 3000 feet, where there is an interruption to the steady increase. The drop from 93 per cent to 89 per cent near the 3000-foot level is probably due to an excessive value just below the 2500-foot level, brought about by the kite passing through a cloud at this level on three or four occasions.

Observations at Nassau, June 27, 1903.

Time.	Elevation of kite.	Atmospheric conditions. Surface. Pressure.	Surface. Temperature.	Surface. Humidity.	Surface. Wind direction and velocity.	At kite. Pressure.	At kite. Temperature.	At kite. Humidity.	Ascent for 0.1 inch of pressure decrease.	Ascent for 1° F. of temperature decrease.
a. m.	*Feet.*	*Inches.*	°	%		*Inches.*	°	%	*Feet.*	*Feet.*
[a]10:55	0	30.05	83	74	ese., 10	30.03	83	73	0	0
11:34	585	30.05	83	74	..do ...	29.40	77	78	90	98
11:36	642	30.05	83	74	..do ...	29.40	78	76	99	128
11:41	758	30.05	83	74	..do ...	29.00	75	82	72	95
11:43	827	30.05	83	74	..do ...	29.00	75	82	79	103
11:52	896	30.05	83	74	..do ...	29.00	75	84	85	112
11:55	1089	30.05	83	74	..do ...	28.80	74	85	87	131
Noon.	750	30.05	83	74	..do ...	29.40	78	81	115	150
p. m.										
12:12	602	30.05	83	74	..do ...	29.43	78	80	97	150
12:15	377	30.05	83	75	..do ...	29.70	78	80	108	94
12:19	430	30.05	83	75	..do ...	29.60	79	80	96	108
12:23	*572*	30.05	83	75	..do ...	29.70	79	79	106	93
12:26	425	30.05	83	76	..do ...	29.60	79	79	94	106
12:29	266	30.05	83	76	..do ...	29.80	80	78	106	90
12:30	0	30.05	83	76	..do ...	30.05	83	76	0	0

[a] 6 cumulus, 10 a. m. to noon. Average pressure decrease 0.10 inch per 95 feet. Average temperature decrease 1° F. per 112 feet. Figures in italic are interpolations.

Observations at Nassau, July 1, 1903.

Time.	Elevation of kite.	Atmospheric conditions. Surface. Pressure.	Surface. Temperature.	Surface. Humidity.	Surface. Wind direction and velocity.	At kite. Pressure.	At kite. Temperature.	At kite. Humidity.	Ascent for 0.1 inch of pressure decrease.	Ascent for 1° F. of temperature decrease.
a. m.	*Feet.*	*Inches.*	°	$.		*Inches.*	°	%	*Feet.*	*Feet.*
10:00	0	30.05	83	75	ese.,15	30.05	83	75	0	0
10:12	1,053	30.05	83	75	..do ...	29.37	77	85	155	150
[a]10:20	1,235	30.05	83	77	..do ...	29.00	75	90	118	137
10:30	1,711	30.05	83	77	..do ...	28.60	73	94	118	156
[b]10:40	2,066	30.05	83	67	..do ...	28.40	73	97	125	188
10:50	2,057	30.05	83	67	..do ...	28.20	72	100	111	171
[c]10:53	2,112	30.05	83	67	..do ...	28.10	71	100	108	162
[d]11:00	2,280	30.05	83	72	..do ...	27.80	69	100	101	152
11:10	2,023	30.05	83	72	..do ...	27.80	70	92	112	187
11:20	2,382	30.05	83	72	..do ...	27.80	70	90	106	170
11:32	2,265	30.05	83	70	..do ...	27.80	70	90	101	162
11:40	2,476	30.05	83	70	..do ...	27.98	72	82	120	206
p. m.										
12:04	1,900?	30.03	83	75	..do ...	28.20	73	90	104	173
12:23	2,393	30.03	83	75	..do ...	27.60	69	96	107	173
[e]12:52	2,334	30.03	83	75	..do ...	27.83	70	99	106	167
[f]1:05	2,495	30.03	83	74	ese.,11	27.78	69	98	111	166
1:15	2,440	30.03	83	74	..do ...	28.00	71	90	120	188
1:25	1,968	30.03	83	74	..do ...	28.09	72	90	97	164
1:40	2,281	30.03	83	74	..do ...	27.90	71	93	107	175
2:00	1,837	30.02	82	84	..do ...	28.10	72	93	95	153
2:20	2,176	30.02	82	84	..do ...	28.10	72	87	113	181
[g]2:28	2,024	30.02	82	78	..do ...	28.10	72	90	105	184
2:40	2,010	30.02	82	78	..do ...	28.20	73	90	110	201
[h]2:49	2,067	30.02	81	72	..do ...	28.30	72	93	120	118
3:00	1,812	30.02	81	72	..do ...	28.30	73	85	105	201
3:10	2,218	30.02	81	73	..do ...	28.20	71	87	122	202
3:20	1,840	30.02	81	73	..do ...	28.58	73	87	112	204
3:40	1,614	30.02	81	73	..do ...	28.40	73	85	100	179
3:50	1,165?	30.02	81	73	..do ...	28.70	76	81	98	194
[i]4:00	1,230	30.02	82	77	..do ...	28.70	75	75	93	154
[j]4:05	1,121	30.02	82	77	..do ...	28.75	76	82	88	160
4:10	1,298	30.02	82	79	..do ...	28.62	75	82	93	162
4:15	1,023?	30.02	82	79	..do ...	28.80	76	75	85	148
4:20	1,083	30.02	82	79	..do ...	29.00	77	80	106	180
4:25	785	30.02	82	79	..do ...	29.20	78	78	90	147
4:30	.....	30.02	82	.....	..do ...	29.60	80	70	.....	.....
4:40	0	30.02	82	79	..do ...	30.02	82	70	.....	.....

[a] 5 cumulus, 2 alto-cumulus. [b] Light scud under kite. [c] Kite in cumulus at 10:57 a. m. [d] Light rain; kite in cumulo-nimbus. [e] Kite in cumulus. [f] Kite obscured by cumulus. [g] Whole sky clouded in region of kite. [h] Kite in cumulo-nimbus. [i] Thunder at 4:05 p. m. [j] A few cirrus clouds apparently moving northward. Average pressure decrease 0.10 inch per 107 feet. Average temperature decrease 1° F. per 173 feet.

Observations at Nassau, July 2, 1903.

Time.	Elevation of kite.	Atmospheric conditions. Surface. Pressure.	Surface. Temperature.	Surface. Humidity.	Surface. Wind direction and velocity.	At kite. Pressure.	At kite. Temperature.	At kite. Humidity.	Ascent for 0.1 inch of pressure decrease.	Ascent for 1° F. of temperature decrease.
p. m.	*Feet.*	*Inches.*	°	%		*Inches.*	°	%	*Feet.*	*Feet.*
3:18	0	30.03	86	72	ese., 9½	30.03	86	72	0	0
3:42	1,656	30.03	86	72	..do ...	28.50	75	73	108	151
[a]3:52	1,605	30.03	86	72	..do ...	28.60	75	75	112	146
4:04	1,872	30.03	85	73	..do ...	28.40	73	76	115	156
4:14	2,526	30.03	85	73	..do ...	27.60	70	90	104	168
4:24	1,643	30.03	85	73	..do ...	28.40	74	90	95	149
4:32	1,890	30.03	85	73	..do ...	28.20	72	93	103	145
4:40	2,455	30.02	85	74	..do ...	27.80	70	95	111	164
4:50	1,829	30.02	85	74	..do ...	28.36	83	92	110	152
5:00	1,473	30.02	85	75	..do ...	28.60	74	90	104	134
5:10	1,412	30.02	85	75	ese., 8	28.80	75	88	116	141
5:20	1,318	30.02	85	75	..do ...	28.65	75	90	96	132
[b]5:25	1,831	30.02	85	75	..do ...	28.20	72	87	101	141
5:30	1,430	30.02	84	75	..do ...	28.80	73	90	101	130
5:32	817	30.02	84	75	..do ...	29.10	77	88	89	117
5:36	619	30.02	84	75	..do ...	29.20	76	80	86	77
5:38	662	30.02	84	76	..do ...	29.40	77	80	107	95
5:48	0	30.02	84	77	..do ...	30.02	83	70	.....	.....

Clear day. [a] 4 cumulus from the southeast. [b] 3 cumulus from the southeast. Average pressure decrease 0.10 inch per 104 feet. Average temperature decrease 1° F. per 136 feet.

Observations at Nassau, July 3, 1903.

p. m.	*Feet.*	*Inches.*	°	%		*Inches.*	°	%	*Feet.*	*Feet.*
5:30[a]	0	30.03	83	63	ese.,12	30.00	83	.....	.....	.....
5:36	.....	30.03	83	63	..do ...	29.65	81	62	.....	.....
5:41	1,643	30.03	84	80	..do ..	29.20	78	68	.....	.....
5:48	1,910	30.03	83	80	..do ...	28.60	74	80	.....	.....
[b]5:55	2,068	30.03	83	80	..do ...	.....	.....	.....	.....	.....
[b]6:00	2,305	30.03	83	77	..do ...	.....	.....	.....	.....	.....
6:11	3,070	30.03	75	77	..do ...	.....	.....	.....	.....	.....
6:18	2,825	30.03	75	77	..do ...	.....	.....	.....	.....	.....
[c]6:21	3,246	30.03	75	77	..do ...	.....	.....	.....	.....	.....
[d]6:27	3,425	30.03	76	85	..do ...	.....	.....	.....	.....	.....
6:35	3,184	30.03	76	85	..do ...	.....	.....	.....	.....	.....
[e]6:47	*3,207*	30.03	76	85	..do ...	.....	.....	.....	.....	.....
6:54	3,674	30.03	76	85	..do ...	.....	.....	.....	.....	.....
7:00	3,858	30.04	78	85	ese., 8	*26.30*	*65*	.....	.....	.....
[f]7:14	3,856	30.04	78	85	..do ...	.....	.....	.....	.....	.....
7:30	2,900	30.04	80	85	..do ...	.....	.....	.....	.....	.....
7:42	2,237	30.04	80	85	..do ...	.....	.....	.....	.....	.....
7:50	2,030	30.04	80	85	..do ...	.....	.....	.....	.....	.....
8:05	1,040	30.04	79	85	..do ...	.....	.....	.....	.....	.....
8:15	957	30.04	79	85	..do ...	.....	.....	.....	.....	.....
8:20?	0	30.04	.....	.....	..do ...	.....	.....	.....	.....	.....

[a] Azimuth of kite changed from 100° to 110°. [b] Azimuth of kite returned to 100°. [c] Kite entered cloud at 6:15 p. m. [d] Squall with rain, 6:20 p. m. [e] 6 cumulus with occasional cumulus nimbus. [f] 6:44 kite in or over cumulus. [g] Began to lower kite at 7:16 p. m. Figures in italic are interpolations.

*Observations at Nassau, July 6, 1903.**

p. m.	*Feet.*	*Inches.*	°	%		*Inches.*	°	%	*Feet.*	*Feet.*
11:10	0	30.05	83	73	ese., 12	30.03	83	73	0	0
11:20	904	30.05	83	73	..do ...	28.60	74	85	62?	100?
11:25	2,532	30.05	83	73	..do ...	27.78	69	93	112	181
11:30	2,825	30.05	83	73	..do ...	27.52	69	90	112	200
11:35	2,500?	30.05	83	73	..do ...	27.40	68	90	94	167
[a]11:40	2,792	30.05	83	73	..do ...	27.20	68	80	98	186
[b]11:45	2,855	30.05	83	73	..do ...	27.20	67	85	100	178
11:50	2,925	30.05	83	73	..do ...	26.90	66	90	93	172
11:55	3,115	30.05	83	73	..do ...	26.80	67	95	96	195
[c] Noon	2,875	30.05	83	73	..do ...	*27.20*	*67*	.....	*101*	*184*
p. m.										
[d]12:05	3,564	30.05	83	73	..do ...	*26.52*	*64*	.....	*101*	*184*
12:10	3,455	30.05	83	73	..do ...	*26.63*	*64*	.....	*101*	*184*
[e]12:15	3,600?	30.05	83	73	..do ...	*26.49*	*63*	.....	*101*	*184*
12:23	3,850	30.05	83	73	..do ...	26.40	63	98	105	192
[f]12:25	3,700	30.05	83	73	..do ...	*26.45*	*63*	.....	*101*	*184*
12:30	3,375	30.05	83	70	..do ...	*26.71*	*65*	.....	*101*	*184*
12:35	3,560	30.05	83	75	..do ...	*26.53*	*64*	.....	*101*	*184*
12:40	3,328	30.05	83	75	..do ...	*26.76*	*65*	.....	*101*	*184*
12:45	3,256	30.05	83	75	..do ...	*26.83*	*65*	.....	*101*	*184*
12:50	2,935	30.05	83	75	..do ...	*27.14*	*67*	.....	*101*	*184*
12:55	2,500	30.05	83	75	..do ...	*27.58*	*69*	.....	*101*	*184*
1:00	1,948	30.05	83	75	..do ...	*28.12*	*72*	.....	*101*	*184*
1:05	905	30.05	83	75	..do ...	*29.15*	*78*	.....	*101*	*184*
1:12	0	30.05	83	75	..do ...	30.05	.....	.....	.....	.....

* On board steam launch *Alicia*; length 25 feet, width 8 feet, speed 5 knots. [a] 3 cumulus; wind from east; kite in cumulus cloud. [b] Cumulus cloud passed over kite. [c] Kite in cloud. [d] Kite in cloud. [e] Kite entered cloud. [f] Kite left cloud. Average pressure decrease 0.10 inch per 101 feet. Average temperature decrease 1° F. per 184 feet. Figures in italic are interpolations.

It may be of interest to record the relation existing between the length of wire out and the angular and vertical elevation of the kite. This relationship is shown in the following table, in which the average values for all observations of each flight are given:

Relation between length of wire and elevation of kite.

Date.	Number of observations.	Average length of wire.	Average angular elevation.	Average elevation of kite.
		Feet.	° ′	*Feet.*
June 27	12	1081	38 0	637
July 1	34	3547	33 39	1869
July 2	16	2722	38 36	1565
July 3	18	3979	44 42	2635
July 6	22	4728	42 30	2865
June 27–July 6	102			
Means		3211	39 28	1914

The average ratio of elevation to length of wire for all heights is a trifle less than 0.60. This value is based on 102 observations. The ratio varied but little throughout the experiments. The average ratio for 18 elevations exceeding 3000 was 0.59. The average angular elevation of the kite was 39° 28′ for all observations, and 38° 30′ for the 18 elevations exceeding 3000 feet.

THUNDERSTORMS AT LINCOLN, NEBR.

By JAMES H. SPENCER, Observer, United States Weather Bureau, dated Lincoln, Nebr., December 19, 1903.

The following extracts, revised to December 1, 1903, are from an article on Thunderstorms, by Mr. James H. Spencer, Observer, United States Weather Bureau, Lincoln, Nebr., which was officially published in the Proceedings of the Nebraska Academy of Sciences, Vol. VII:

Thunderstorms have more than usual interest to the residents of most of the States lying between the Mississippi River and the eastern slope of the Rocky Mountains. In this great region they probably supply not less than two-thirds of the precipitation during the summer months, and crop failure or success depends very largely upon their frequency, extent, and the amount of rainfall.

* * * * * * *

Careful records of thunderstorms have been kept for Lincoln, Nebr., since April 1, 1896, and although a longer record is necessary to establish trustworthy averages for comparison, the statistics deduced from the record for the eight years ending November 30, 1903, particularly for the crop seasons will be found of interest.

The total number of thunderstorms passing over the station[1] for the entire period was 302, or an average of 38 for each year. About 50 per cent occurred during the night (from 7:00 p. m. to 7:00 a. m.) and about 70 per cent. between noon and midnight. Nearly 90 per cent. were recorded as coming from some westerly direction. Two hundred and forty-four of the 302 thunderstorms, or 81 per cent. of the entire number, occurred during the forty months of the eight crop seasons—from April to August, inclusive—the time of year in Nebraska when moisture is most needed. The distribution of the storms by years, and for the five months of the crop season, the total rainfall for each month, and the approximate amount which fell during thunderstorms, are given in the foling table:

Thus it is found that about 70 per cent. of the total amount of rainfall for the crop season is due to the passage of thunderstorms, and that the percentage of rainfall from thunderstorms during the most critical crop months in Nebraska—July and August—is still greater. The average rainfall for each crop season, excluding that due to thunderstorms, was only 6.25 inches.

* * * * * * *

The maximum wind velocity for the eight years, and the highest ever recorded for five minutes at Lincoln, was 80 miles per hour, occurring in the thunderstorm of May 12, 1896. No very great damage resulted from this storm.

The year 1900 furnished an unusual number of excessive wind and precipitation records for Lincoln. Both the number of thunderstorms and the rainfall were considerably above the normal. During the thunderstorm of July 15 over 3 inches of water fell, more than two-thirds of which occurred in one hour. A month later, on August 16 and 17, 4.27 inches of water fell in twenty-four hours, an amount more than 1 inch in excess of the normal rainfall for that month. During the thunderstorm of August 23, 0.61 of an inch was recorded in five minutes. At this rate our entire annual precipitation would occur in less than four hours. During the storm of August 21 occurred the highest wind velocity for the year, averaging 78 miles per hour for five minutes, but for one minute exceeding 100 miles per hour. Hundreds of trees were blown down or had large limbs blown off and the roofs of a number of buildings were badly damaged.

The summer of 1902 also gave some very interesting thunderstorm data for Lincoln. Tho total rainfall for June and July was 20.18 inches, or within 6.58 inches of the yearly normal; of this amount 86 per cent. occurred during thunderstorms. The July rainfall was 11.35 inches, or three times the normal amount. It is interesting to note that of this amount only 0.89 of an inch occurred during the twelve hours ending at 8 p. m.

The thunderstorm of May 26, 1903, was the most destructive on record at the station. A maximum wind velocity of 76 miles an hour was recorded. About one mile southwest of the office the storm appeared to be even more severe, and several large buildings were damaged by the wind to the extent of nearly $100,000.

[1] The instructions for Weather Bureau observers require that thunderstorms be recorded when thunder is heard at the station, without reference to any other feature.—ED.

Thunderstorms at Lincoln, Nebr.

Year and month.	Number of thunderstorms.	Precipitation (in inches). Total for month.	Total during thunderstorms.
1896.			
April	3	4.57	2.62
May	8	10.11	4.20
June	5	3.05	2.43
July	4	5.63	3.92
August	3	3.39	1.77
Total for crop season	23	26.75	14.94
1897.			
April	3	6.15	2.96
May	3	2.22	1.32
June	3	2.17	0.63
July	0	2.54	0.00
August	5	2.69	1.82
Total for crop season	14	15.77	6.73
1898.			
April	3	3.88	0.22
May	4	4.33	2.90
June	3	3.99	1.26
July	3	3.93	3.69
August	3	3.45	2.68
Total for crop season	16	19.58	10.75
1899.			
April	4	1.49	0.87
May	12	2.29	1.57
June	11	8.39	8.35
July	4	1.47	1.15
August	6	2.66	1.74
Total for crop season	37	16.30	13.68
1900.			
April	7	4.33	1.44
May	7	4.50	4.14
June	11	2.50	2.44
July	9	6.66	5.78
August	7	9.07	8.91
Total for crop season	41	27.06	22.71
1901.			
April	1	1.46	0.53
May	3	1.96	1.69
June	9	1.42	1.24
July	5	2.94	2.88
August	7	1.02	0.78
Total for crop season	25	8.80	7.12
1902.			
April	3	0.67	0.11
May	9	3.65	1.34
June	11	8.83	7.20
July	13	11.35	10.21
August	7	4.35	3.87
Total for crop season	43	28.85	22.73
1903.			
April	3	3.59	2.73
May	12	10.72	7.57
June	7	2.60	1.52
July	11	3.07	3.07
August	12	6.45	5.93
Total for crop season	45	26.43	20.82
Total for 8 crop seasons	244	169.54	119.48
Average for each crop season	30.5	21.19	14.94

RECENT STUDIES ON THE SOLAR CONSTANT OF RADIATION.

By C. G. ABBOT. Reprinted from Smithsonian Miscellaneous Collections (Quarterly Issue), volume 45. Published December 9, 1903. (Revised by the author.)

INTRODUCTION.

Within the last two years the observations of the Smithsonian Astrophysical Observatory under the direction of the

Secretary, Mr. Langley, have been largely for the purpose of measuring the total solar radiation, its distribution in the spectrum, and the losses which it suffers by absorption in the solar and terrestial gaseous envelopes. In the experimental work and reduction of observations Mr. Langley has been aided by the writer, but chiefly by F. E. Fowle, jr., whose able handling of the work I wish particularly to acknowledge and commend. Preliminary notices of this investigation have appeared in the Smithsonian Report for 1902, and in an article by the Secretary in the Astrophysical Journal for March, 1903, to which sources the reader is referred for additional information in relation to the methods of study. In the present paper will be found a summary of the results thus far reached.

ATMOSPHERIC ABSORPTION.

It is well known that the effectiveness of the solar and terrestial gaseous envelopes to intercept by reflection or absorption and thus diminish the intensity of the solar radiations at the earth's surface, varies greatly for rays of different wavelengths. It is customary, speaking of the matter in ready though not strictly accurate terms, to combine these two effects of reflection and absorption under the single head of absorption, but to distinguish two kinds of absorption, namely, general and selective, of which the latter includes such sudden alterations of transmission as are seen in the Fraunhofer lines, while the former denotes merely a general weakening of the radiation extending over wide ranges of wave length. Using this nomenclature, it appears to be the general absorption of the solar and terrestial envelopes which chiefly affects the amount of solar radiation at the earth's surface, although the selective absorption of water vapor in the atmosphere is also both very effective and very variable.[1]

The procedure employed here to determine the general absorption of the air consists chiefly in making bolographs—that is, automatic energy spectra—of the solar radiation as often as possible throughout days of uniform and excellent sky without alteration of the sensitiveness of the apparatus. Such energy spectra are altered in appearance from one to another by the varying absorption of the different thicknesses of air, so that a little after noon the height of the curve is found to be a maximum for all wave lengths, and the height falls off as the sun declines in altitude, slowly in the infra-red region of the spectrum, but more and more rapidly as we examine further and further toward the violet, or still more rapidly if we note the greater atmospheric absorption bands due to water vapor.

It is assumed that the atmospheric transmission for a very narrow portion[2] of spectrum may be expressed by the relation—

$$e = e_0 a^{m\frac{\beta}{\beta_0}} \tag{1}$$

where e and e_0 are the intensities of light of this wave length at the earth's surface and outside the atmosphere respectively; a the fraction transmitted by the atmosphere for zenith sun; m the air mass, or ratio of the length of the transmitting column of air to that for zenith sun; β and β_0 the observed and standard barometer readings respectively. Upon the bolograph the height d corresponding to any given wave length is directly proportional to the amount of energy of that wave length. Accordingly we may introduce a factor k constant for the single wave length in question

$$d = ke = ke_0 a^{m\frac{\beta}{\beta_0}} \tag{2}$$

and hence,

$$\log d = m\frac{\beta}{\beta_0}\log a + \log (ke_0). \tag{3}$$

As the last term of equation (3) is to be supposed constant during the day's observations, the expression is in the form of the equation of a straight line, and if the logarithms of the deflections at the given wave-length on the successive bolographs be plotted as ordinates with the quantities $(m\,\beta/\beta_0)$ as abscissæ, the several points so determined should fall on a straight line of which the tangent of the inclination is the logarithm of the transmission coefficient (a) for the given wave length.

Mr. Langley has stated that the attempted measurements of the solar constant from a station near sea level like Washington are subject to great uncertainty from the necessity of the very large and doubtful extrapolation for atmospheric absorption. Without in the least questioning this, and while calling special attention to the great interest which would attach to a repetition of the experiments at high altitudes, I incline to the belief that the closeness with which the plotted points, determined as above described, lie upon a straight line for wide ranges of air mass is a reasonably sure criterion of the accuracy of the extrapolation. In order to give an impression of the weight which should be assigned to the solar constant values shortly to be given, I call attention to fig. 1, which contains the plots for deducing atmospheric transmission at several wave lengths for two days, March 25, 1903, and March 26, 1903, observations for the two days being represented by circles and crosses respectively. The tangent of the angle of inclination of the plotted lines is the logarithm of the coefficient of transparency of the atmosphere for vertical transmission of a ray of the given wave length. Plots I and II represent a wave length of 1.027 μ; III and IV, 0.656 μ; V and VI, 0.468 μ; and VII and VIII, 0.395 μ. In connection with this branch of the subject, it is well to remark what the experience of meteorologists generally no doubt confirms, that the afternoon hours are found far more uniform as to transparency of the air than the morning hours, so that the observations of atmos-

[1] K. Ångström has, however, attributed much importance to the absorption of carbonic acid gas, implying by his computation that not less than 61 per cent of the solar radiation which reaches the outer layers of the earth's atmosphere is cut off by the absorption of this gas in a vertical transmission through the air. (See Annalen der Chemie und Physik, vol. 39, pp. 309-311, 1890.) He locates the absorption of this gas principally in the bands at 2.6μ and 4.3μ; so that, as he says, its effect is not allowed for in the procedure for obtaining the value of the solar constant of radiation adopted by Mr. Langley in his research on Mount Whitney, and which is essentially that employed here. Ångström, while using the same method in part, added a second term amounting to more than half the whole in his computation, solely referring to the absorption of carbonic acid gas, and thus he obtained his oft-quoted result for the solar constant of radiation of 4.0 calories per square centimeter per minute. For several reasons I am inclined to think Ångström has greatly overestimated the importance of this carbonic acid absorption term: First, as he shows, the selective absorption of carbonic acid gas is almost wholly for wave lengths greater than 2.5μ and principally in two bands between wave lengths 2.5μ and 2.85μ and between 4.20μ and 4.50μ, respectively, where the total amount of the solar radiation is apparently less than one per cent of the whole, as determined not only from the appearance of the observed bolographic solar spectrum energy curve itself, but from a consideration of the probable temperature of the sun and the distribution of energy in the spectra of bodies at high temperatures. As a very evidently too great estimate of the energy in these wave-length regions, it may be seen that if the radiation outside the atmosphere (see fig. 3) was of the same intensity throughout these bands as at 2.1μ, the area they would include would be only about one-fiftieth the total area under the curves of fig. 3. It is of course very improbable that the height of the curve at 4.3μ is nearly as great as at 2.1μ. Thus it would appear that the selective absorption of this gas for direct solar radiation is almost negligible. Second, if carbonic acid exercised a general absorption through the more intense parts of the solar spectrum, it is not apparent why such a general absorption is not included and allowed for in the coefficients of absorption here determined. Third, values of the solar constant computed here for the same day, but from observations made through very different thicknesses of air, are found to agree excellently, which appears to confirm the accuracy of the method of determining the atmospheric absorption which is here employed.

After the first publication of this paper my attention was drawn to Ångström's later article on this subject. (Ann. d. Physik, 4, 3, 720, 190.) I am glad to find that he now attaches much less importance to the absorption by CO_2 of solar radiation, and, in consequence, that he now discountenances the value 4.0 cal., so often quoted for the solar constant.

[2] In our practise less than the width between the D lines.

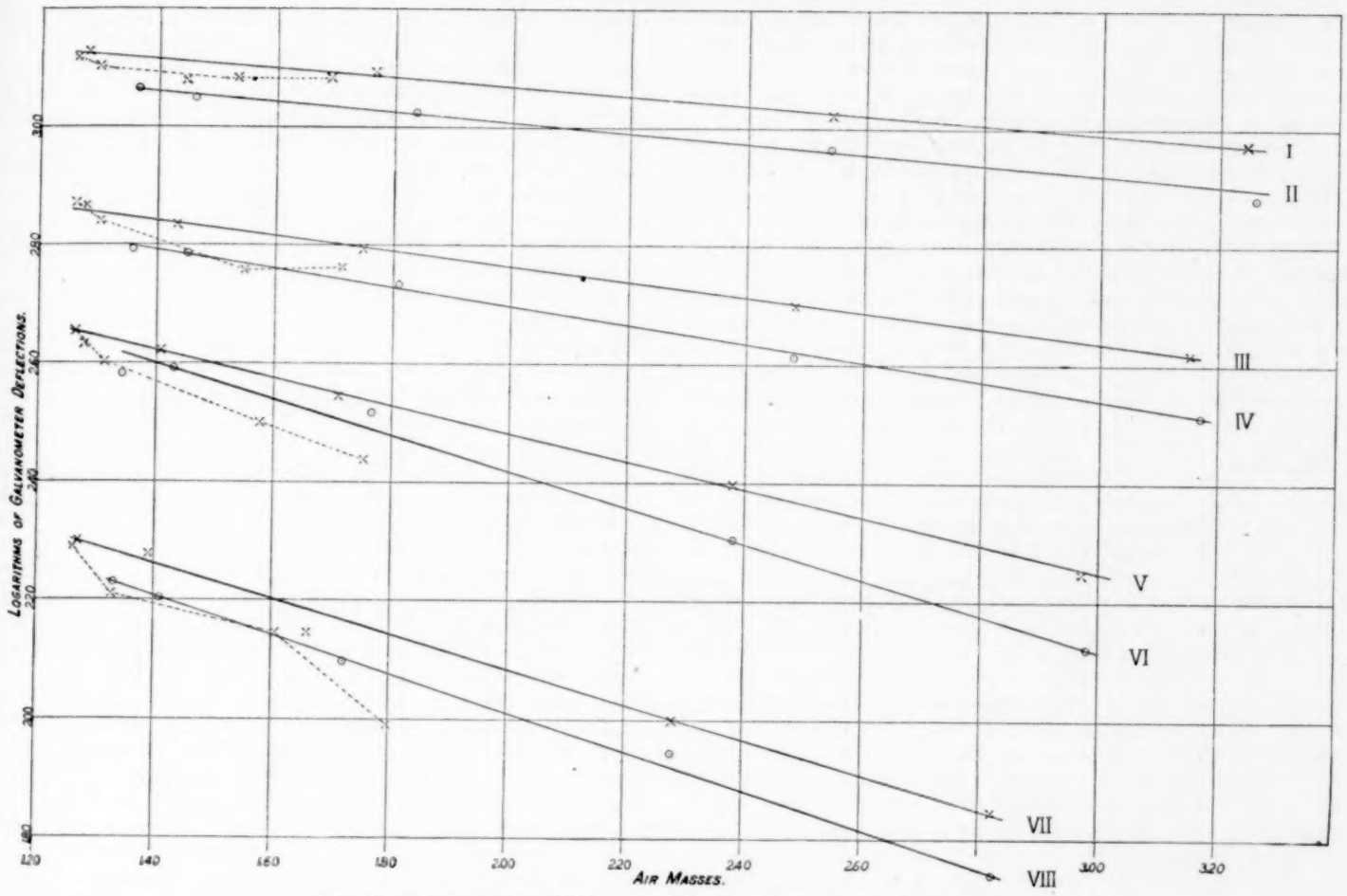

FIG. 1.—Transparency of the atmosphere from bolographic observations.

TABLE 1.—*Coefficients of atmospheric transmission for radiation from zenith sun.*

Wave-length.	0.40 μ.	0.45 μ.	0.50 μ.	0.60 μ.	0.70 μ.	0.80 μ.	0.90 μ.	1.00 μ.	1.20 μ.	1.60 μ.	2.00 μ.
Date.	Transmission coefficients for unit air mass.										
October 25, 1901	.....	.....	0.81	0.82	0.89	0.94	.....	0.95	0.96	0.95	.....
November 2, 1901	.....	.....	0.80	.....	0.87	0.92	.....	0.94	0.95	0.94	.....
March 21, 1902	.....	.....	0.83	0.80	0.84	.....	.....	.....	.....	0.87	.....
May 8, 1902	.....	.....	0.89	0.77	0.90	0.94	.....	0.95	0.94	0.91	.....
September 11, 1902	.....	.....	0.80	0.78	0.87	0.89	0.92	0.92	0.94	0.93	.....
October 9, 1902	.....	.....	0.70	0.78	0.84	0.87	0.89	0.90	0.91	0.93	.....
October 15, 1902	.....	.....	0.73	0.78	0.86	0.89	0.90	0.91	0.93	0.96	0.94
October 16, 1902	.....	.....	0.50	0.58	0.79	0.82	.....	0.86	0.90	0.91	.....
October 22, 1902	.....	.....	0.84	0.82	0.88	0.91	0.93	0.94	0.94	0.95	.....
November 15, 1902	.....	.....	0.75	0.79	0.83	0.89	0.91	0.92	0.93	0.95	0.96
February 19, 1903	0.67	0.64	0.66	0.72	0.76	0.80	0.83	0.85	0.86	0.90	0.92
February 25, 1903	0.48	0.60	0.66	0.68	0.74	0.83	0.88	0.90	0.93	0.93	0.92
March 3, 1903	0.40	0.48	0.66	0.73	0.79	0.84	0.87	0.89	0.92	0.96	0.96
March 25, 1903	0.47	0.50	0.57	0.66	0.72	0.76	0.79	0.81	0.84	0.88	0.89
March 26, 1903	0.52	0.58	0.62	0.68	0.77	0.80	0.81	0.83	0.85	0.89	0.90
April 17, 1903	0.55	0.60	0.69	0.77	0.80	0.82	0.87	0.90	0.94	0.97	0.97
April 28, 1903	0.39	0.52	0.56	0.64	0.71	0.74	0.76	0.78	0.82	0.88	0.89
April 29, 1903	0.46	0.49	0.56	0.66	0.72	0.76	0.77	0.80	0.83	0.88	0.90
July 7, 1903	0.42	0.60	0.66	0.69	0.77	0.82	0.85	0.86	0.88	0.89	0.86
General mean	0.484	0.557	0.700	0.730	0.808	0.847	0.856	0.884	0.903	0.920	0.919
Mean of 1901–2	.....	.....	0.765	0.769	0.857	0.897	0.910	0.921	0.933	0.930	0.950
Mean of 1903	0.484	0.557	0.627	0.692	0.753	0.797	0.825	0.847	0.874	0.909	0.912
Percentage difference between mean of 1903 and that of 1901–2	.....	.....	20%	10%	13%	12%	10%	8.4%	6.5%	2.3%	4.1%

These wave lengths were selected to avoid large terrestial absorption bands and the coefficients present the effect of the general absorption only.

pheric transmission for use in computing values of the solar constant have been obtained chiefly in the afternoon. Forenoon observations are distinguished in fig. 1 by being connected by dotted lines.

In order to fix our ideas as to the magnitude and the variability of the absorption of the earth's atmosphere, the preceding Table 1, showing the percentage of transmission at numerous different wave lengths for the days indicated, is given. The computations upon which the table is based were made at wave lengths specially selected to avoid large terrestrial absorption bands, and thus the table gives values of the general absorption only. A few reductions have been made to determine the selective absorption within the numerous atmospheric bands of water vapor and oxygen, but while their discussion has gone far enough to show that equation (1) apparently holds good in these bands, the results are not yet far enough advanced to be included in the tables. As another criterion of the accuracy of the method of extrapolation, and in accord

with what has just been said, it is found that in computations of the form of the solar energy curve outside the atmosphere, the employment of the observed values of transmission within the water-vapor bands would practically fill up these bands: However, in determining the solar constant they have been smoothed over and the general transmission constants corresponding to smoothed curves are employed in the computation.

The days included in Table 1 were all nearly cloudless, and thus the results represent the transmission of the atmosphere in better than average conditions. In order to bring out clearly what seems to be a marked decrease in the transparency of the air for the present calendar year, the means of the general transmission coefficients have been taken for the observations of 1901–2, and for those of 1903 separately. There is an average difference of 10 per cent in favor of the earlier years, and this can not, so far as I know, be accounted for in any other way than by recognizing an actual decrease in the transparency of the air, beginning somewhere between November 15, 1902, and February 19, 1903. It might be urged that the change is perhaps an annual one, as most of the observations of 1901–2 are in the autumn, and those of 1903 in the spring. But, in contradiction to this view, we find the observations of March and May, 1902, generally above the mean of that year, so that I incline to think the change rather extraordinary than annual in character. Such a change would imply a corresponding reduction in the amount of direct solar radiation received at the earth's surface, and if general over a wide area would seem to be likely to occasion some alteration of climate. Recent actinometric observations reported by several observers in this country and in Europe[3] seem to strengthen the probability that the change in transparency of the air is widespread, for their measures of solar radiation at the earth's surface have been appreciably lower of late than for the same months of former years. Several writers have suggested the possibility of the wide dissemination of fine dust clouds from the volcanic eruptions of 1902, in explanation of the lower values. It will be noted from Table 1 that the differences between the means of 1901–2 and 1903 are largest for short wave lengths and diminish nearly uniformly toward the infrared as far as a wave length of 1.2μ, which would probably be in harmony with this hypothesis; for such small dust particles might be expected to scatter and absorb the shorter wave lengths most, not being large enough to act like an opaque screen diminishing all wave lengths proportionally.

COMPUTATIONS OF THE SOLAR CONSTANT OF RADIATION.

The coefficients of general atmospheric transmission resting upon measures at 24 different wave lengths from 0.37μ to 2.3μ on series of bolographic curves have been employed at the Astrophysical Observatory in connection with bolographs and actinometric data to compute the solar constant of radiation outside the atmosphere. Referring to fig. 2 the area included underneath a spectral energy curve is directly proportional to the total radiation absorbed by the bolometer over the range of wave lengths included in the curve. But this area is not strictly proportional to the total solar radiation at the earth's surface, as determined by actinometer observations, for the reason that the radiation has been unequally reduced at different wave lengths by losses at the siderostat mirror, and within the spectroscope, and also by selective absorption at the bolometer itself. It is necessary to correct the curve so that it shall as accurately as possible represent the distribution of energy in the solar beam prior to these losses. Inasmuch as the coefficient of total absorption of the lampblacked bolometer strip is upward of 95 per cent, it is believed that no considerable error is admitted by neglecting its differences of absorption for different wave lengths, and no correction is applied for these. The relative absorption of the spectroscope for different wave lengths is frequently determined, and that of the siderostat mirror still more frequently; for in both these optical parts of the apparatus there is rapid deterioration of the reflecting power of the silvered glass surfaces. At present this indeed forms one of the main difficulties and sources of error of the investigation, for a whole day of observing and several days of computing are required for each determination of the absorption of the apparatus, which would be determined once and for all if constant reflecting surfaces could be employed.

By means of the coefficients of absorption of the apparatus thus determined, the area included under the bolographic curve is to be increased so that the total corrected area is then proportional to the solar radiation at the earth's surface as measured with the actinometer or pyrheliometer. Then by the aid of formula 1, given above, and employing the transmission coefficients determined from the series of bolographs of the day, the area is again corrected till it becomes proportional to the total radiation outside the atmosphere. The ratio of the area as corrected for atmospheric absorption to the area corrected only for instrumental absorption is the factor by which the reduced pyrheliometer reading is to be multiplied to give the "solar constant" so called.[4]

It is evident that these "solar constant" values depend directly upon the pyrheliometer or actinometer readings for their accuracy, so that these instruments become here of major importance. In the work thus far a mercury pyrheliometer has been used as the primary standard, and the daily observations have been taken sometimes with it, sometimes with a Crova alcohol actinometer (specially constructed for this Institution under M. Crova's valued supervision), and sometimes with both instruments simultaneously. It has been shown by repeated comparisons of the two instruments and by comparisons of the pyrheliometer with another type that they give proportional results under widely differing conditions of wind and temperature, so that I have no question as to the relative accuracy within 2 per cent of the actinometric data employed in computing values of the "solar constant." There is, on the other hand, room for question as to the absolute magnitudes of the values given, for these depend on the constants and the theory of the mercury pyrheliometer. Steps are being taken to get further checks on this matter, and in a later publication it is expected to recompute the data in accord with later information. For the present, then, the values in the following Table 2 are to be held as relatively accurate and consistent among themselves, but subject later to correction by a common multiplying factor.

The bolographs used in the computations extend from wave lengths 0.37μ to wave length 2.5μ with the exception of those of October, 1902, which reached only to a wave length of 0.48μ in the violet. For these latter bolographs a correction of about 12 per cent was applied, founded on the later work, and thus the results for October, 1902, are entitled to slightly less weight on this account. All the areas have been extrapolated for the radiations lying outside at both ends of the region 0.37μ to 2.5μ, but the corrections so applied amount to less than one per cent altogether. Their magnitude was determined by an inspection of the rate of decrease of successive corrected areas approaching the limits of the curves, and the corrections were checked both by computing according to Wien's formula the probable form of the solar energy curve corresponding to the assumed solar temperature of 6000°, and by examination of the normal energy curves outside the atmosphere as computed from bolographs and given in fig. 3.

I have thought it worth while to give, in addition to the

[3] See note by H. H. Kimball, Monthly Weather Review, May, 1903.

[4] In computing these corrected areas the bolograph is divided into 24 regions, each of which is separately reduced by applying the mean coefficients of atmospheric and instrumental transmission within the region in question. As already stated, the water vapor absorption bands are smoothed over and corrected for atmospheric absorption by aid of general transmission coefficients.

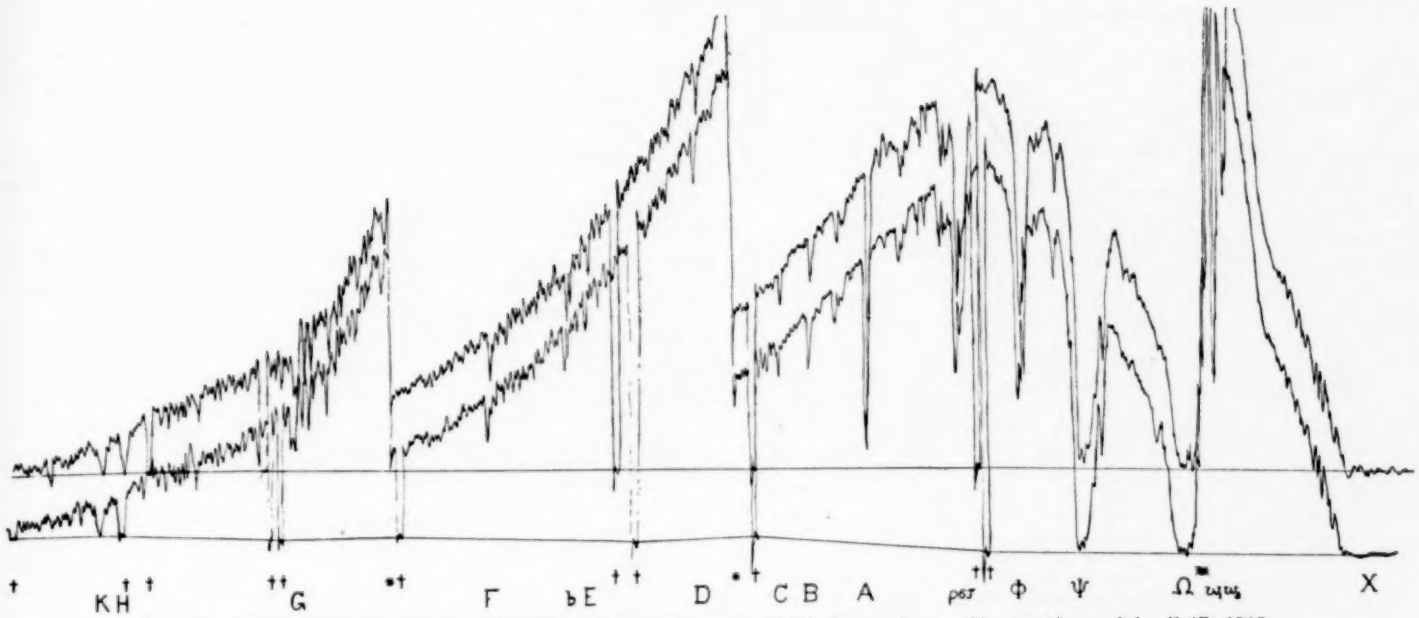

FIG. 2.—Bolographic energy curves of the solar spectrum of a 60° glass prism. Observations of April 17, 1903.

(† Beam cut off by shutter to give position of zero line. * Slit diminished by interposing grill diaphragms. ** Slit increased by removing grill diaphragms.)

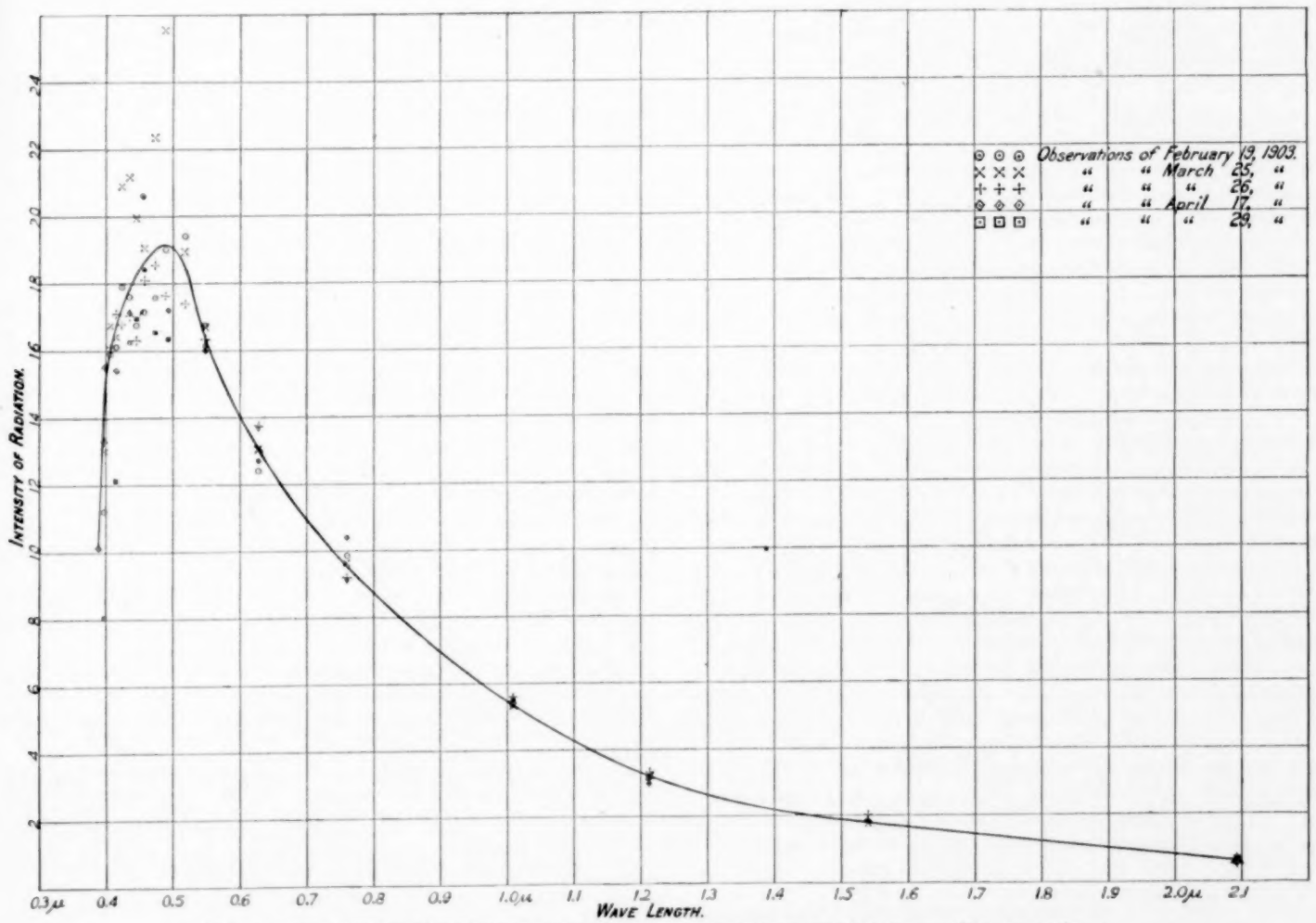
Observations of February 19, 1903.
" " March 25, "
" " " 26, "
" " April 17, "
" " " 29, "
INTENSITY OF RADIATION.
WAVE LENGTH.
0.3μ 0.4 0.5 0.6 0.7 0.8 0.9 1.0μ 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 1.9 2.0μ 2.1

FIG. 3.—Distribution of radiation in the normal solar spectrum outside the earth's atmosphere.

TABLE 2.—*Values of the solar constant of radiation. From bolographic studies.*

Date.	Hour angle. West.	Air mass.	Calories per square centimeter per minute.		Solar constant; for mean distance of the sun.
			At the earth's surface.	Outside the atmosphere.	
1902.	A. m.		*Calories.*	*Calories.*	
October 9	0 6	1.425	1.42	2.20	2.19
October 15	1 31	1.624	1.44	2.21	2.19
October 22	3 01	2.415	1.30	2.18	2.16
1903.					
February 19	1 01	1.642	1.35	2.34	2.28
February 19	2 22	2.003	1.20	2.31	2.25
March 3	0 59	1.429	1.34	2.31	2.26
March 25	2 01	1.454	1.19	2.29	2.27
March 26	1 57	1.438	1.16	2.11	2.10
March 26	2 59	1.754	1.05	2.09	2.07
April 17	2 45	1.463	1.19	1.97	1.99
April 28	1 07	1.145	1.29	2.23	2.27
April 29	2 26	1.308	1.05	1.93	1.97
General mean					2.167
Mean of results prior to March 26, 1903					2.229
Mean of results after March 26, 1903					2.080

general mean, the means also of observations before and after March 26, when, for some unexplained reason, a fall of about 10 per cent was noted in the computed solar constant. The observations of February 19,[5] March 25, 26, and April 29, 1903, appeared to be entitled to the greatest weight among those given, on account of the regularity of the actinometric curves of those days and the closeness with which the plotted points for determining the atmospheric transmission coefficients lie upon straight lines, as shown for two of the days in question on fig. 1.

FORM OF THE NORMAL SOLAR ENERGY SPECTRUM OUTSIDE THE EARTH'S ATMOSPHERE AND THE PROBABLE TEMPERATURE OF THE SUN.

The reader has no doubt noted that, by applying corrections for atmospheric and instrumental absorption, the bolographic spectrum energy curves may be reduced in form as well as in area to represent the distribution of energy in the spectrum of the solar beam outside the atmosphere. This has been done in several instances, and in doing so the curves have been transformed from the prismatic to the normal wave-length scale by taking account of the prismatic dispersion, and several of these curves are plotted on fig. 3 In these curves no account is taken of selective absorption bands, whether solar or terrestrial, smoothed curves only being given.

It will be noted that there is a fair agreement in general form between these independently derived curves, and that they unite in fixing the wave length of maximum energy at about 0.49 μ.[6] Their agreement would be more exact, there can be little doubt, if it were not for the large and variable absorption of the silvered surfaces in the optical apparatus for wave lengths at and beyond the region of maximum energy. The transmission of the spectroscope at a wave length of 0.45 μ has varied on this account at different times from 33 per cent to 15 per cent, whereas at wave lengths of 1 μ and thereabouts the transmission always approaches 90 per cent. The spectroscope mirrors are resilvered about once in two months and the siderostat mirrors still oftener.

Wien has derived a law connecting temperature with wave length of maximum radiation, which is expressed as follows, where T is the absolute temperature and λ_{max} the wave length of maximum intensity of radiation expressed in microns:

$$\lambda_{max} T = \text{constant.}$$

The value of this constant for the radiation of a "black body" or perfect radiator as determined by Paschen,[7] Lummer and Pringsheim,[8] and others is about 2900, while for bright platinum Lummer and Pringsheim give 2630 with values for other substances intermediate between these.

Taking the higher value in connection with the observed position of maximum in the solar energy curve outside the atmosphere, we find that as regards the wave length of maximum radiation the sun's radiation may be assumed comparable to the emission of a "black body" at 5920° absolute. Readers will draw their own conclusions as to the probability that the solar temperature actually lies near this value. It may be remarked that a further correction of the energy spectrum curve for the selective absorption of the solar envelope would undoubtedly reduce the wave length of maximum radiation still further, and would thus incline us to the view that the interior of the sun is at a higher temperature than the above considerations alone would indicate.

[5] February 19, 1903, was the most extraordinary day as regards absence of water vapor in the atmosphere which has ever been noted here. The great water-vapor bands ϕ ψ in the infra-red spectrum were nearly filled up, and the long wave length side of the band Ω presented an almost unrecognizable appearance.

[6] The wave length of maximum energy determined by Mr. Langley on Mount Whitney was about 0.52 μ.

TREES AS FORECASTERS OF RAIN.

By CURTIS J. LYONS, Honolulu, Hawaii, dated October 15, 1902.

With respect to the query on page 315 of the MONTHLY WEATHER REVIEW for June, 1902, as to whether leaves of trees and shrubs turn up their lower sides previous to rain, the fact is this: A steady wind does not cause the leaves to turn in this way, because the leaves adjust themselves on the twigs of the tree or shrub to the wind in that particular direction. But a sudden change in wind seems to take the leaves unawares, and they immediately show their undersides until they become accustomed to the new direction. That is exactly what takes place before a thunderstorm. A change from trade wind to southerly or westerly wind here always shows the under side of the leaves. Curiously enough a sudden gust while the writer was reading the note in the WEATHER REVIEW gave an instance of the very thing in question.

CLIMATOLOGY OF COSTA RICA.

Communicated by Mr. H. PITTIER, Director, Physical Geographic Institute.
[For tables see the last page of this REVIEW preceding the charts.]

Notes on the weather.—On the Pacific slope, the rainfall was exceptional for the season, with strong northerly winds and much dampness. In San José, pressure and humidity were normal, with a slightly lower temperature; after the 8th it rained most of the time, with a heavy and cold northeast wind. Sunshine one hundred and one hours against a normal of one hundred and fifty-eight hours. The instability of the weather delayed the coffee picking, and the strong and damp winds, quite unusual at this time of year, were very prejudicial to the public health. On the Atlantic slope the rainfall was excessive, causing everywhere inundations and landslides. The only way of communication with Port Limon, i. e., the Costa Rica Railroad, has been interrupted for a distance of 13 miles, and has suffered many other damages.

Notes on earthquakes.—December 16, 10^h 36^m a. m., slight shock NW.–SE., intensity II, duration 3 seconds. Another slight earthquake was reported from Tres Rios on the 20th.

THE POLAR AURORA OF OCTOBER 30-NOVEMBER 1, 1903.

Communicated by JAMES PAGE, United States Hydrographic Office, dated Washington, December 14, 1903.

During the night of October 30–31, and again during that of October 31–November 1, observers aboard vessels in higher latitudes report having witnessed remarkable displays of the aurora borealis or northern lights. The phenomenon was observed in both the Atlantic and Pacific oceans. (See the report of the steamship *Victoria* given below.) Its occurrence was not simultaneous throughout, different observers recording the appearance and disappearance of the lights at different instants of absolute

[7] Paschen, Astrophysical Journal, IX, 306, 1899.
[8] Verhandlungen d. Deutschen Phys. Ges. III, 37, 1901.

time; nor was it everywhere apparent, certain observers reporting the display, others in the same neighborhood failing to mention it.

In the following list the reports follow each other in the order of longitude.[1]

Night of October 30–31.

October 31, 2:30 a. m. [3:54 a. m.], latitude 57° north, longitude 21° west, aurora borealis in northern sky. British steamship *Oilfield*, O'Niell. Report by Officer Walker.

October 31, 1:30 [4:18] to 2:30 a. m. [5:18], latitude 50° north, longitude 42° west, aurora borealis in north-northwest. Danish steamship *Norge*, Gundel. Report by Officer Anderson.

October 31, 2 a. m. [4:56], latitude 48° north, longitude 44° west, northern lights showing in rays and waves; at 6 a. m. [8:56] became red, blending into a dark purple; the clouds, between masses of nimbus, showing white on top and olive green to black. British steamship *Weehawken*, Harding. Report by Officer M. J. Kay.

October 30, 7 p. m. [10:20 p. m.], latitude 45° north, longitude 50° west, had a splendid northern light; it covered the whole north part of the sky. German steamship *Phoebus*, Schierhorst. Report by Officer Gerdelmann.

October 30, —, latitude 46° north, longitude 50° west, aurora borealis. British steamship *Ethiopia*, Lunsdane. Report by Officer McDonald.

October 31, —, latitude 44° north, longitude 54 west, saw a magnificent aurora borealis. Dutch steamship *Rotterdam*, Stenger. Report by Officer Prijl.

October 31, at daybreak [8:40–9:40 a. m.], latitude 46° north, longitude 55° west, remarked an exceedingly strong northern light with reddish color. German steamship *Frisia*, Leuenfels.

October 31, 5 to 6 a. m. [8:52–9:52 a. m.], latitude 43° north, longitude 58° west, very strong northern lights, radiated, changeable from red to bright, visible above an arc of 45°. Danish steamship *Dania*, Paulsen. Report by Officer Jörgensen.

October 30–31, latitude 39° north, longitude 68° west, after the moon had set, about 2 a. m. of October 31 [6:38 a. m.], a strange phenomenon manifested itself. The whole northern sky was illuminated with a pale light; this lasted until morning. Although very far south for this, we were without doubt in view of the aurora borealis. French steamship *America*, Bouleuc. Report by Officer Besseyre.

October 31, latitude 40° north, longitude 70° west, from midnight to 4 a. m. [4:40–8:40 a. m.], northern lights. German steamship *Geestemunde*, Hellmeyer. Report by Officer Gerdelman.

October 30–31, latitude 33° north, longitude 76° west, aurora borealis seen during the night. British steamship *Bawtry*, Jackson. Report by Officer Mills.

October 31, 2 a. m. [11:32 a. m.], latitude 49° north, longitude 143° west, saw the northern lights very visible to the eastward. American steamship *Victoria*, Truebridge. Report by Officer Kenny.

Night of October 31–November 1.

November 1, 1 a. m. to 5 a. m. [1:08 to 5:08 a. m.], latitude 58° north, longitude 2° west, a strong northern light was seen in the direction north by east, through east, to southeast. I never saw such a strong northern light before. Dead calm at the time. Danish steamship *L. P. Holmblad*, Anderson. Report by Officer Hansen.

October 31, 8 to 12 p. m. [8.08 p. m. October 31 to 12:08 a. m. November 1], latitude 59° north, longitude 2° west, brilliant display of aurora borealis extending over the whole sky. British steamship *Appalachee*, Simpson. Report by Third Officer Simpson.

October 31, 8 p. m. [8:40 p. m.], latitude 49° north, longitude 10° west, saw a beautiful northern light. American steamship *Kroonland*, Doxrud. Report by Officer Eisleben.

October 31, toward midnight [Nov. 1, 1:08 a. m.], latitude 55° north, longitude 17° west, brilliant display of aurora borealis. British steamship *Sarmatian*, Pitts.

October 31, 8:30 p. m. [9:54 p. m.], in latitude 51° 18′ north, longitude 20° 55 west, wind south (true), blowing very strong, with barometer at 29.79 and falling smartly, the sky at north-northeast became suddenly illuminated with bright light, which rapidly diffused the whole of the northern half of the heavens with bright shafts of light, all converging to a focus at the zenith with large areas of copper-colored light, changing to a very dark red and traveling from north-northeast to west, contrasting strongly with the white shaft of light and making the display one of exceptional character and beauty, the whole display lasting for ten minutes. Flashes two and three to the second with intervals of several seconds. British steamship *Columbus*, McAuley. Report by Second Officer Bentley.

October 31, 10:40 p. m. to November 1, 4 a. m. [12:24 to 5:44 a. m.], latitude 56° north, longitude 26° west, aurora borealis in northern sky. British steamship *Oilfield*, O'Neill. Report by Officer Walker.

October 31, 7 p. m. [9:08 p. m.], latitude 41° north, longitude 34° west, observed the rays of a north light, which lasted about five minutes and then disappeared. German steamship *Sicilia*, Bachmann. Report by Third Officer Oettjen.

October 31, 8:30 p. m. [10:50 p. m.], to November 1, 2 a. m. [4:20 a. m.], latitude 52° north, longitude 35° west, strong northern lights were seen from north-northeast, through north, to southwest. Danish steamship *Norge*, Gundel. Report by Officer Andersen.

October 31, latitude 51° north, longitude 37° west, the whole night electric appearance of the northern lights. German steamship *Standard*, Shuiter. Report by Second Officer Schulte.

October 31, latitude 46° north, longitude 47° west, the northern lights rose to a great height, assuming all the colors of the rainbow, the rays bending and meeting in a point a few degrees south of the zenith; afterwards changing to white and showing throughout the night (October 31-November 1) in flashes, rays and waves, at times lying in the zenith like cirrus. British steamship *Weehawken*, Harding. Report by Officer Kay.

October 31, at midnight [November 1, 3:08 a. m.], latitude 45° north, longitude 47° west, northern lights showing very bright. British steamship *Eagle Point*, Bovey.

October 31, latitude 49° 55′ north, longitude 48° 00′ west, during all the night northern light. German steamship *Deutschland*, Dallsdorf.

October 31, latitude 46° north, longitude 49° west, 10 to 11:30 p. m. [November 1, 1:16 to 2:46 a. m.], very light flashes flying up in quick succession in the northern horizon from northwest to northeast (northern lights). Dutch steamship *Ocean*, Boysen.

October 31, 8 to 12 p. m. [October 31, 11:20 p. m., to November 1, 3:20 a. m.], latitude 44° north, longitude 50° west, saw the aurora borealis faintly in the sky. British steamship *Manchester Inventor*, Parry. Report by Officer Dolg.

October 31, 10 p. m. [November 1, 1:52 a. m.], latitude 43° north, longitude 58° west, northern lights were visible. British steamship *Ohio*, Ward. Report by Officer Kendrick.

October 31, latitude 48° north, longitude 65° west, 6 to 10 p. m. [October 31, 10:20 p. m., to November 1, 2:20 a. m.], noticed a strong northern light, sometimes covering the western part of the sky completely; color of the light was reddish. German steamship *Frisia*, Von Leuenfels.

October 31, latitude 41° north, longitude 60° west, during the night the light of aurora borealis was seen over 25° altitude. Austrian steamship *Lacroma*, Paravic. Report by First Officer Ticoc.

In addition to the above, brilliant auroras were observed on October 26, November 16, 18, and 21.

[1] Some of this data was published in the Pilot Chart of the North Atlantic Ocean for December, but additional data has been added by Mr. Page. The ship's local time of observation has been converted into Greenwich time by the Editor and is inserted in the text in brackets.—*C. A.*

Telegraph wires and cables, from the Pacific coast eastward throughout America and Europe, report very general and intense ground currents, lasting about eight hours in Chicago and eight to twelve hours in Europe. At New York City this began about 2 a. m. October 31, and continued for seven hours. It was generally considered as the worst electrical disturbance experienced in the United States for thirty-five years past. In Europe, telegraphic disturbances were most serious in Switzerland and France, but were not noticed in Austria, Italy, or Denmark. However, such reports as these have a very indefinite significance, owing to the fact that very different sorts of apparatus are used by the various telegraphic services. Brilliant auroras were recorded at most stations from Oregon to Newfoundland, beginning at 1 a. m., and ending at 5 a. m.

At Chicago the climax occurred at 8:30 a. m., having begun about midnight.

A preliminary report by Father de Moidry of a remarkable magnetic perturbation which manifested itself at the Zi-Ka-Wei Observatory, Shanghai, China, simultaneously with the above auroral display, has been received. The opening paragraph of this report is as follows:

October 30, at 10 hours (Greenwich civil time 1h. 55m. p. m.), our three needles underwent a sudden fluctuation, a frequent preliminary of the more important storms, sinking after a quarter of an hour into profound calm. During October 31 the condition of agitation was resumed, reaching a climax at 21–22 hours (Greenwich civil time 13–14 h. p. m.). At this moment the total amplitude of the most rapid oscillation was:

For D	23.5′
For H	388γ
For Z	137γ

The perturbation continued until November 1, twenty-two hours.

An idea of the excessive character of this disturbance may be gathered from the fact that the greatest untroubled diurnal oscillation of the declination measured at Zi-Ka-Wei since 1877 was but 14.5′ in six hours of time, July 12, 1884. The above displacement of 23.5′ occupied but fourteen minutes of time.

NOTES AND EXTRACTS.

FORMATION OF HAILSTONES.

A recent letter from Mr. William M. Taylor, at Guthrie, Okla., forwarded by Section Director C. M. Strong, describes a thunder and hailstorm as follows:

In the spring of 1868, at Arlington, Okla., I had the pleasure of observing a severe electrical and hailstorm. From 4 to 5 p. m. there was a continuous flashing of lightning, mostly forked, with very little thunder. About 6 p. m. it commenced to hail; the sky had a greenish cast and before the hail began to fall a rumbling noise was heard like stones clashing together. The first hail that fell was small, about the size of birds' eggs, but as the storm advanced they grew larger, until some of them crashed through the roof of the hotel and other buildings, including the roof of my shop, which was covered with three thicknesses of oak boards and had a slope of one in four. I examined several of these hailstones; one of them measured 3½ by 4½ inches in diameter. One was weighed by a friend and weighed 14 ounces. I broke several of them open to see their interior formation. The smallest had a center of white ice, with a coating of clear ice surrounding it. The next larger size was like the first, with an additional coat of white ice, and on that a coat of clear ice. Each successive larger size had additional double coats of white ice and clear ice. The largest had five double coats besides the center.

Although it has long been known that large hailstones are formed of concentric layers of clear ice and snowy ice, and although Espy and Ferrel long since plausibly explained this concentric formation on the assumption that the hailstones were carried alternately from the altitude called "rain stage" through the layer called "hail stage" into the upper layer known as the "snow stage" and back again, several times, we have not yet attained to what may be called a perfect demonstration of the truth of this very plausible hypothesis. In Ferrel's Recent Advances (Washington, 1885), and elsewhere, he has given some drawings illustrating his idea on the subject. His drawing on page 309 appears to suggest that hailstones of the larger size may be carried from the height of 2000 meters up to 8000 and back again over and over, until they have acquired a number of concentric coatings of ice and snow, but this is an extreme case and quite unnecessary. The beautiful graphic methods of Herz and von Bezold, and the more elaborate tables published by Professor Bigelow, or the new diagrams published by Neuhoff, show that for any given condition of the atmosphere the so-called hail stage, in which raindrops are freezing into ice, occupies only a thin horizontal layer somewhere in the midst of an ordinary cumulus cloud, and this layer is at the most only a few hundred meters thick. Therefore, a hailstone need only go up and down vertically a few hundred meters, in order to receive a layer of snow or white ice, and down again a few hundred meters in order to acquire a layer of cold water. This vertical oscillation need not be represented by a curve like *AB*, followed by the direct fall to the ground *BC*, but rather resembles a curve, *XYZ*, such as would be described by a particle drawn in from a great distance outside of the storm at *X* and gradually ascending into the interior of the cumulus cloud at *Y* before it is brought to the ground at *Z* by its increasing weight. The altitude at which the hail stage occurs depends upon the temperature and humidity of the air, and is somewhat higher in the interior of the cloud than at its exterior, as represented by the stratum *HH* in fig. 1.

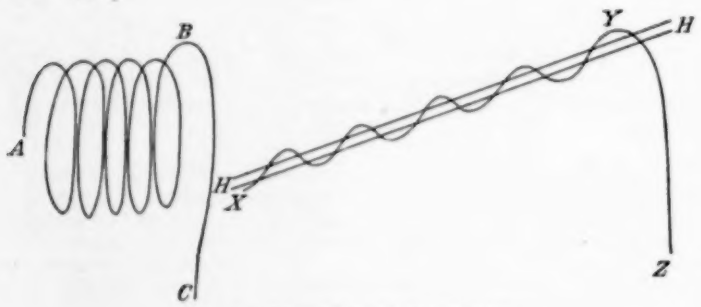

FIG. 1—Formation of hailstones.

WEATHER BUREAU MEN AS INSTRUCTORS.

Prof. Henry J. Cox, in charge at Chicago, states that classes in physiography in the schools of Chicago and vicinity frequently visit the office of the Weather Bureau. Fourteen such visits occurred during 1903. One of these classes was from the University of Chicago, another, a class in physics, from the Young Men's Christian Association Technical School, and the remainder were from the high schools and normal schools of Chicago. On each occasion a lecture was delivered, either by Professor Cox or by one of his assistants, upon the working of the Weather Bureau instruments, the methods employed in forecasting, etc.

On December 16, 1903, Mr. D. A. Seeley, Observer, lectured before the Oakland Culture Club at one of its regular monthly meetings on "Meteorology and Weather Forecasting."

Mr. Weston M. Fulton, Local Forecaster, reports the delivery of a lecture at Chattanooga, Tenn., on December 18. Between 2000 and 2500 persons were present, and considerable interest was manifested in the subject.

Mr. J. R. Weeks, Observer, Weather Bureau, Macon, Ga., delivered the first of a series of lectures December 23 before the students of the Gresham High School on "The Weather and the Weather Bureau."

METEOROLOGY AND THE ART OF FLYING.

During the past four years a series of most interesting experiments have been going on on the coast of Dare County, N. C., not far from the Weather Bureau station at Kittyhawk. Here the brothers, Wilbur and Orville Wright, of Dayton, Ohio, have established a camp and all the necessary apparatus for experiments in what is known as gliding flight. The apparatus, which is a form of aeroplane, is launched from the summit of a sand hill, and after making a long glide finally comes to rest on the sands below. After several years of experience and careful study of the currents and winds that blow over the sand hills, the Messrs. Wright have applied motor machinery to their aeroplanes. Their success is undoubtedly due in great part to the preliminary careful study of the winds, and for this reason, although machinery is essential, yet we consider that meteorology also has played an important part in their work. Their latest official announcement is that on December 17 four flights were made. The wind record at Kittyhawk was 24 to 27 miles per hour at 30 feet above the ground, but at the flying station it was about 22 miles per hour at 4 feet above ground. These flights were made from the level ground, against the wind, with no assistance from gravity: after a horizontal run of 40 feet the aeroplane rose with the operator on a very gentle incline to a height of 8 or 10 feet from the ground, after which the course was kept as nearly horizontal as the wind gusts and the limited skill of the operator would permit, and the flyer made its way forward with a speed of 10 miles per hour over the ground, or 30 to 35 miles per hour relative to the air. The fourth flight occupied 59 seconds and the machine flew through a distance of 852 feet over the ground, or about three times that distance relative to the wind; it landed earlier than was necessary, owing to a slight error of judgment on the part of operator.

The Messrs. Wright state:

It had not been our intention to make any detailed public statement concerning the private trials of our power "Flyer" on the 17th of December last; but since the contents of a private telegram, announcing to our folks at home the success of our trials, was dishonestly communicated to newspaper men at the Norfolk office, and led to the imposition upon

the public by persons who never saw the "Flyer" or its flights, of a fictitious story incorrect in almost every detail; and since this story, together with several pretended interviews or statements, which were fakes pure and simple, has been very widely disseminated, we felt impelled to make some corrections. The real facts were as above.

THE THERMOPHONE APPLIED TO GEODESY.

We have several times had occasion to call attention to the convenient and accurate thermophone of Messrs. Henry E. Warren and George C. Whipple, who applied it first to the measurement of the temperature of water in lakes and afterwards to the temperature of the soil. We now also call attention to its application in determining the temperature of a base measuring tape, as used in geodesy. We quote the following from a recent report by John F. Hayford, published as Appendix No. 3 in the Annual Report of the United States Coast and Geodetic Survey for 1901:

Little has yet been published in regard to this apparatus (See Technology, Quarterly, June, 1901, p. 82). It has been developed gradually during the last fourteen years by students of the Massachusetts Institute of Technology, acting under the direction of Prof. A. E. Burton, several theses having been written on different phases of the subject.

The important feature of this form of tape apparatus is the device for obtaining the temperature of the tape. The whole length of the 100-meter tape and an approximately equal length of German-silver wire form two of the arms of a Wheatstone bridge. The two variable arms of the bridge, together with the telephone which is substituted in the place usually occupied by a galvanometer, and the necessary interrupter, batteries, and connections form the thermophone proper. The thermophone has been patented by Messrs. Henry E. Warren and George C. Whipple, and is manufactured by E. S. Ritchie & Sons.[1]

It has been used for determinations of temperature in various ways, and the work of the students at the Massachusetts Institute of Technology now under consideration is mainly that of developing this apparatus to use with long measuring tapes.

The electrical resistance of the steel tape varies more rapidly with a change of temperature than does that of the German silver. The ratio of the resistance of the tape to that of the German silver is, therefore, a measure of their temperatures. Or, with sufficient accuracy, it is a measure of the temperature of the tape, provided the German silver is similarly exposed, so as to have approximately the same temperature as the tape. This ratio is the quantity really measured by the thermophone. The thermophone dial, over which moves a pointer which indicates the position of the contact point regulating the two variable arms of the bridge, is graduated so as to indicate the temperature of the tape in Fahrenheit degrees.

In regard to the Massachusetts Institute tape apparatus as a whole, the writer is convinced: That with the thermophone apparatus in its present form, and using all refinements, measures can be made even in daylight, and when the temperatures are varying rapidly, with a much higher degree of accuracy than is possible with tapes and mercurial thermometers even under good conditions at night.

PERIODS IN SOLAR RADIATION AND TERRESTRIAL TEMPERATURES.

An important communication from Mr. C. G. Abbot of the Astrophysical Observatory, "Recent Studies of the Solar Contant of Radiation," is reprinted in this number of the MONTHLY WEATHER REVIEW.

It is true that the Editor's article in the American Journal of Science, 1870, vol. 750, p. 345, did seem to show that the temperatures observed at Hohenpeissenberg, when treated by a purely statistical method, support the idea that the sun sends us less heat at the time of the sun-spot maximum and that the diminution amounts to about 0.8° R. for 100 units in Wolf's relative sun-spot numbers. For a long time after that publication the Editor believed that it might be possible to establish an intimate connection between solar radiation and solar spots, but the steady development of our knowledge of the selective absorption of the earth's atmosphere has shown that we can not argue by crude statistical methods from terrestrial temperatures up to solar radiation. We may speak of periods and variations in our temperatures, but these do not demonstrate similar periods in the sun's temperature or in its radiations, since unsuspected periodic variations in the earth's atmosphere may be the cause of the variations that we should otherwise attribute to the sun itself.

When we consider the temperature of the earth's atmosphere in and of itself, without asking where the heat comes from, we do find slight traces of irregularities that seem sometimes like regular periods. But these irregularities and periods do not necessarily originate in the sun, even though some of them do show that our low temperatures come at the time of sun-spot maxima. It is quite as likely that they originate in the earth's atmosphere by the combined action of moisture, winds, or currents. It is demonstrably impossible for any period whatever to permanently exist in the earth's atmosphere. We may have forced periods, such as the diurnal and the annual, but there are no natural periods like those of a tuning fork. If a sun-spot period is manifest anywhere, it is either forced and maintained by the sun spots, or else it is a temporary phenomenon that soon dies away. The mere fact that there is a decrease of temperature in the Tropics at sun-spot maximum argues nothing as to a direct relation of cause and effect between the two phenomena. We have on hand a collection of monthly charts of temperature departures for the whole globe for several successive years, which tend to show that the apparent sun-spot periods in the earth's temperature are purely local, terrestrial matters, moving around from one part of the world to the other, just as do our droughts and our rains, our barometric waves, and our cold waves. We have an analogy in the movement of an oceanic earthquake wave over the globe, going sometimes rapidly and sometimes slowly, reflected from a continent, exaggerated in some arm of the ocean, breaking in waves on a shore, but scarcely felt on an island in mid-ocean, and finally dying out by virtue of innumerable interruptions, as all forced waves do unless they happen to be reinforced by a process similar to that of resonance in sound waves.

If in thus speaking of sun-spot periods and lunar periods as matters of minor importance to meteorology we have seemed to dissuade anyone from spending his time in study along those lines, we have done this with a view, not to discouraging research, but to urging that attention be given to more important fields of research. If one is so constituted that he can study nothing but solar and lunar periods, then let him do that, and possibly some benefit to meteorology may result; but to one who has any general ability in research we must urge that he take up what may be called the internal mechanism of our atmosphere, or the movements and phenomena that must occur in a complex atmosphere resting on the variegated surface of the earth under the influence of a constant emanation from the sun. He will find within the atmosphere a series of periodicities due to the diurnal rotation and the annual revolution of the earth; another series due to the dimensions of the globe and the mass of the atmosphere, and still another series due to the variations of land and water, vapor, cloud, and rain or snow. We would have our best men unravel this internal mechanism before studying the less important and rather problematic celestial influences.

SOUTHPORT EXHIBITION OF METEOROLOGICAL APPARATUS.

At the Southport meeting of the British Association, August, 1903, there was, as usual, an exhibition of scientific apparatus which, on the present occasion, referred especially to meteorology and terrestrial magnetism. The catalogue of the exhibition covers 30 pages, and includes, among other things, the following items that will interest the meteorologist on account of their rarety or novelty:

1. Maps of the world, showing the isobars for June 21, September 21, and December 21, 1901, and March 21, 1903.

[1] Mr. Warren writes that it is now manufactured by the Lombard Governor Co., of Boston, of which he is superintendent.—ED.

2. Self-register of the changes of pressures of the gas in the gasometer at Batavia on August 26–28, 1883, showing the disturbance caused by the eruption of Krakatoa.

3. Barograms from Colaba, Bombay, and Aberdeen, Scotland, for the days between August 26 and September 1, 1883, showing the effect of the eruption on the barometer.

4. Copies of photographic records, showing barometric changes at Radcliffe Observatory, Oxford, due to atmospheric waves connected with the Krakatoa eruption.

5. Copies of barograms at the Radcliffe Observatory, Oxford, during the periods of eruptions of Mount Pelée and La Soufrière, May 4–11, 1902.

6. Curves showing the monthly variation of the temperature of the ground at Radcliffe Observatory, Oxford, at different depths, as determined by platinum resistance thermometers, compared with the air temperature in the shade four feet above the surface.

7. *Meteorological thermometer.*—A fine copper wire wound upon a light mica frame is inclosed for protection in a thin brass tube. The wire readily acquires the temperature of the surrounding air, its electrical resistance changing considerably with change of temperature.

8. *The Calendar recorder for continuous registration of temperature.*—The above-mentioned meteorological or resistance thermometer, arranged for taking the air temperature, is included in one arm of a Wheatstone bridge. When the temperature changes, the bridge balance is upset, and this causes the slider to be automatically moved along the slide wire until the balance is restored. When this recorder is applied to the meteorological thermometer, the recorder corresponds to the variations of electrical resistance of the copper wire, the leads between the recorder and the thermometer being so compensated that their variations of temperature are without effect upon the indications.

9. *Sunshine receiver.*—Two flat zigzag windings of fine platinum wire lie side by side within a glass bulb, hermetically sealed, containing dry air. One of these wires is embedded in a thin layer of black enamel, while the other wire is left bright and has no covering except the bulb. When their temperatures are equal, the two wires are of equal electrical resistance, but the effect of direct sunshine is to raise the temperature of the embedded coil above that of the exposed coil, thus giving rise to a difference of resistance, which is registered by the Calendar sunshine recorder. This recorder is similar to the Calendar temperature recorder described above, but the quantity directly recorded is the difference of resistance of two platinum wires. The total sunshine is estimated as a time integral of intensity, by applying a planimeter to the record obtained.

10. *Indicator connected to the earth-temperature thermometer.*—The thermometer, buried at the point whose temperature is to be observed, is similar to the meteorological or resistance thermometer, described above. The platinum wire resistance is included in one arm of a Wheatstone bridge, the remaining resistances being disposed within the body of the indicator, which also contains a sensitive detector galvanometer of suspended coil type. To take a temperature reading, the position of a slider upon a circular slide wire is adjusted by turning an ebonite head at the top of the case until the galvanometer shows that the point of balance has been reached. The temperature is then directly read off on a dial.

11. *Blakesley portable barometer.*—A tube, closed at one end and open at the other, has a uniform bore of about 1.2 millimeters, and contains a thread of quicksilver about 20 cubic meters long. The length of the body of inclosed air is read in two vertical positions. If A is the length in question when the closed end of the tube is uppermost and B when the open end is uppermost, then the required height of the barometer H is given by

$$H=\frac{A+B}{A-B}L,$$

where L is the length of the thread of quicksilver. If L has been measured once for all at 0° C, no temperature correction is required.[1]

12. Diagrams illustrating a paper by Mr. F. W. Harmer on the meteorology of the glacial epoch, originally published in the Quarterly Journal of the Meteorological Society of London.

13. Two glass positives showing the spectrum of lightning. These were secured by Dr. W. J. S. Lockyer on May 31, 1903, 3 a. m., with a Thorpe grating in front of the photographic objective.

14. *Dine's pressure plate.*—This is attached to the head of a vane so as to face the wind. The small holes on the face of the plate all communicate with an air space inside, and since the holes are all of exactly similar construction and size, and are evenly distributed over the whole surface of the plate, the air pressure inside is very approximately the mean of the pressures on the elements of the face of the plate. There is a similar arrangement for the back of the plate, and a similar statement applies to it. The difference of the pressures in the two air spaces multiplied by the area of the plate gives, therefore, the whole force produced by the wind normal to the face.

This difference of pressure is measured and recorded on the chart of an ordinary pressure tube anemometer, and Mr. Baxendell's experiments have shown that if connecting tubes of suitable size be used the errors due to momentum of the moving parts, which vitiate the records of the ordinary pressure plate, are very trifling.

15. *Besson's harrow nephoscope.*—This instrument consists of a long brass rod, mounted in a vertical position in such a manner that it can revolve freely, and bearing at its upper end a horizontal crosspiece provided with a number of vertical spikes. The observer places himself so that the cloud whose direction of motion is to be ascertained appears in the same straight line as the central spike, and then revolves the crosspiece until the cloud appears to move along the line of spikes, while the observer himself remains motionless. The direction in which the crosspiece is pointing is then read off on a graduated circle provided for that purpose. By observing the time taken for the cloud to pass from spike to spike the angular velocity can be determined.[2]

16. *The gravimetric recording hygrometer of Prof. F. T. Trouton.*—The principle on which the action of this instrument depends is that the *weight* of moisture condensed by bodies such as flannel is, within the meteorological range of temperature, approximately a function of the hygrometric state alone. Thus, when the moisture in the air varies, or the temperature changes, the weight absorbed by a piece of flannel also changes; not, however, in proportion to the amount of moisture present, but in proportion to the hygrometric state. This alteration in weight is shown by the movement of the arm of a balance from which the flannel is suspended, and is recorded by means of an inked stylus, on graduated paper, revolving with a clock-driven drum.

17. *The electrical dew-point hygrometer af Prof. F. T. Trouton.*—The moment of deposition of moisture on a hygrometer of the Dines type is announced by the completion of an electric circuit effected by the deposed moisture. Two long parallel wires are affixed to the surface of deposition. These wires form the electrodes of a circuit containing a battery and indicating instrument. While the circuit is dry there is insulation, but on dew forming the current can pass between the wires. The apparatus can be adapted for use with an automatic recording instrument for giving a record of the dew-point at frequent intervals. It is also of use in positions where the moment of deposition of dew can not be observed by the eye.

18. *Sunshine recorder of Mr. A. Lander.*—A novel instrument in which the sensitive paper is stationary, and the pin hole or narrow slit is revolved by means of clockwork. The slit is close to the sensitive surface of the paper. The instrument is made of aluminum, and is small and light. It gives a very sharp and perfect record and is very sensitive.

19. *Anemometer of Mr. A. Lander.*—This instrument records both direction and pressure, the latter by means of a delicately counterpoised rubber bellows, which is raised by the pressure of the wind and lifts a small conical float suspended in glycerine.

20. *Thermograph of Mr. A. Lander.*—Made with a compound strip of extraordinary sensitiveness to temperature, so that it gives a movement of nearly one inch for difference of 10° F. without the magnification by levers.

THE DIFFUSION OF ODORS IN THE ATMOSPHERE.

The Editor has been accustomed to say that one of the direct evidences of the presence of slowly ascending currents of air is to be found by studying the behavior of buzzards, vultures, and other birds that feed on carrion. We see these birds low down in the horizon at the limit of vision, sailing round and round all day long, until finally, sometimes after the lapse of two or three days, they have been able to trace the smell of their food from great altitudes downward to its location on the ground. The distance from which they come, often a hundred miles, and the vertical height from which they have to descend, perhaps 10,000 feet as an extreme case, give us some idea of the gentle slope of these so-called ascending currents, which are twisted and contorted into every imaginable shape by the wind.

[1] Unfortunately, the Editor does not find the name of Blakesley in our index to meteorological literature, and can not refer to the date of the invention of this portable barometer, but it may be worth stating that he himself, quite independently, devised precisely the same method as a method of illustrating the subject to a class of students in 1882. The results obtained by this simple apparatus would be unexceptionable were it not for the effect of the uncertainty of the influence of capillarity in tubes that are only 1 or 2 millimeters in diameter.—*C. A.*

[2] If an ordinary hand rake be set up with the handle vertical, the head bar and the teeth will be horizontal. If the handle turns about its vertical axis, the head bar can be set in such a position that the cloud under observation may appear to travel from one end of the bar to the other. The direction in which the head bar points is then the true azimuth of the motion of the cloud, and its velocity may be determined by counting the number of teeth passed over in one minute. Of course Besson's apparatus applies only to clouds near the zenith. The ordinary nephoscope can be used for clouds within 15° of the horizon. Another form devised by the Editor in 1871, but not yet constructed, would allow of observations down to the horizon itself, if this were ever desired in meteorology.—*C. A.*

The strength of the argument to the effect that the descending track of the buzzard proves the existence of ascending currents of air lies in the assumption that the odor is carried upward by simple convection. Now Prof. John Zeleny, of the University of Minnesota at Minneapolis, has made a study of the rate of diffusion of odors in still air, and has communicated his results to the American Association for the Advancement of Science at its meeting in St. Louis in December, 1903. It is evident that if diffusion were more rapid than convection, then our argument would fall to the ground, but the contrary seems to be the case.

Professor Zeleny writes as follows:

In answer to your inquiry in regard to my experiments on the rate of propagation of smell, I beg to say that I find that smell diffuses very slowly. To prevent the disturbance due to convection currents, the experiments were carried on by having the odors diffuse through glass tubes of small diameter. As an example, it took over two hours before the smell of ammonia was detected at the end of a tube a meter and a half long. For shorter distances, the time required was roughly proportional to the square of the distance.

It seems, therefore, that the rapid way in which an odor spreads through a room is due almost entirely to convection currents.

Your elegant way of proving the existence of ascending currents in the atmosphere surely can not be affected by diffusion phenomena, since their effect is so slow.

I was especially interested in making my experiments to see if the particles producing smell might not be subatomic. The slowness of the diffusion is against this. But we do not know how much stuff is necessary before we can recognize the smell. Ammonia I could detect as soon chemically as with my nose. A peculiarity appears in camphor (large molecular weight) where in a vertical tube the smell ascended twice as fast as it descended. For ammonia, the rates up and down were about the same.

The only gas that I have used that may come from carrion is H_2S. The odor of this was detected at a meter's distance in about 35 minutes. In the formula $t = kl^2$, which applies roughly for short distances, $k = 0.21$ about, for H_2S and 0.27 for NH_3, t being measured in seconds, and l in centimeters; l is length of tube, and t is the time before the odor is detected at one end of the tube from the substance at the other end.

LOW BAROMETER DURING THE "PRESIDENT" STORM OF MARCH 12, 1841.

Prof. George Davidson, of the University of California, in a letter of December 27 to Prof. Alexander McAdie, says:

A case of excessive low barometer is given in Sir George Simpson's journey round the world in 1841–42. He was making the passage from Liverpool to Halifax in the *Caledonia*, Captain McKellar, a vessel of 1300 tons and 450-horse power. He says, on the morning of the ninth day out (March 12, 1841) Captain McKellar discovered that the barometer had fallen between two and three inches during the night, having descended to 26.9, the lowest point which, in his experience, it had ever reached. He then tells about the storm, and mentions that it was in this very storm that the steamer *President* was lost. "My recollection of a high barometer was in a terrific storm from the northwest, some time near the end of November, 1857. I was then off Barnegat (New Jersey), getting home. My memory puts the barometer at 31.4, but that was on shore."

THE MISCHIEF OF WRONG THEORIES.

During the past century there has been such steady progress in all branches of science that the more intelligent portion of the community has abandoned those notions with regard to astrology, alchemy, spontaneous generation, witchcraft, and other philosophies that were formerly accepted by the most learned. The diffusion of education has raised the children of the present generation above the level of the philosophers of a former generation. And yet we have seen it demonstrated again and again that the popular majority does not fully appreciate the extent of our present knowledge of the laws of the weather, and is still liable to resort to unscientific methods in hope of accomplishing that to which science has not yet attained.

We have seen communities in America and Australia carried away with the idea that cannonading can produce rain, or in Europe that the ringing of church bells or the offering of prayers can avert droughts and floods. In southern Europe the agriculturists are but just recovering from the strange belief that hail can be prevented by shooting rings of smoke toward the clouds. During the past ten years a wealthy engineer of Russia has devoted his fortune to the conversion of the people to his idea that the moon controls the weather, and so seriously does his advocacy of this error affect the uneducated agricultural community that the director of the weather service at Odessa (Klossovsky) has gone to the trouble of publishing an elaborate statement of the errors in fact and theory committed by this engineer. He shows very clearly that Demtchinsky's method of predicting the weather by lunar periods amounts to nothing more than predicting an average condition, an average which very rarely occurs, whereas the departures from it are very frequent. The verifications of these predictions are like the combinations in an ordinary game of chance, where there is an equal number of heads and tails, or hits and misses.

As the collection of meteorological statistics depends so largely upon the voluntary work of thousands of unpaid observers, it is to be feared that the good work we are doing in America may be seriously interrupted if erroneous views are allowed to have an influence in this country as profound as they seem to have in southern Russia.

We can not repeat too often and too clearly the general proposition that meteorology is to be advanced only by studying in details the effects on the atmosphere of insolation, radiation, the diurnal rotation and annual revolution of the earth, and the presence of continents and oceans.

AURORA AND MAGNETIC DISTURBANCES OF OCTOBER 30—NOVEMBER 1, 1903.

On October 30, 31, and November 1, some remarkable disturbances of the magnetic needle, a so-called magnetic storm, were reported from nearly all portions of the globe. Attending this great disturbance there also occurred auroras and earth currents on our globe, and sun spots and solar prominences. Of course this combination of phenomena is very common, as it has long been known that they are all associated together, but the magnetic disturbance of October 31 appears to be the most important that has yet been recorded. Although terrestrial magnetism proper is usually considered to be distinct from meteorology, yet the aurora is always included. We have, therefore, collected a few of the records of its recent appearance.

In the Annuaire of the Meteorological Society of France for November, 1903, the editor, M. Th. Moureaux, Director of the Observatory, Parc Saint-Maur (Seine), publishes a short note on this great magnetic perturbation, in which he says:

Magnetic pertubations have been rare and feeble during 1901, 1902, and 1903. But a more intense and long sustained series of pertubations began October 11, and after a calm interval of several days a new series of exceptional intensity began on October 31. This started suddenly at 6:12 a. m. with a simultaneous jump in the declination needle D and the horizontal component H, and a diminution of the vertical component Z. The great oscillations of D and H began at 7 a. m. and continued without interruption until 10 p. m. Then, between 10 and 11 p. m., H fell off greatly, but the phase of maximum density did not occur until about noon. At this moment Z, which had been but slightly disturbed thus far, rapidly increased, and the two other elements, D and H, experienced rapid and great variations. The observers remained constantly at the apparatus, and noted that D diminished by 1° 39′ in the interval between 1:52 p. m. and 1:55 p. m., but recovered by about 1° 18′ between 2 and 2:05 p. m. During the rapid movement of the declination needle eastward, the two components H and Z increased simultaneously in such a way that the total magnetic force also experienced a great increase at this time. Similar great oscillations were observed at 4 p. m., 5.30 p. m., and 7 p. m. In fact, the magnets were troubled throughout the whole night, and it was only at 2 a. m. of November 1 that Z returned to its normal value. In general the disturbances drove D and H below the average and those of Z above the normal. The extreme amplitudes of the variations were, respectively, 0.00680, or $\frac{1}{25}$ of its absolute value for the horizontal component; 0.00520, or $\frac{1}{81}$ of its absolute value for the vertical component; 2° 4′ for the declination. Disturbances of the same kind

were recorded at all the other five French observatories and in general they were larger than ever before recorded. In England, at Kew, the disturbance of the declination was about 2° 12′ and at Stonyhurst 2° 46′ as compared with 2° 4′ at Val-Joyeux in France.

Sun spots had been observed in October, but there did not appear to be any direct connection between them and the magnetic disturbances; thus, on the 5th of November a new group of spots crossed the central meridian of the sun without any disturbance of the very regular magnetic curves of that day.

It seems, as has been shown by Tacchini, that the magnetic pertubations are less dependent upon the heliocentric longitude of the spots than on the rapid variations in their forms, variations to which they are not all subjected, but of which we can take account, either by direct observation or by a series of photographs. It is necessary moreover to observe not only the spots, but all manifestations of solar activity, that is to say protuberances and faculæ. In the course of the disturbance, the earth currents as observed on telegraph wires and cables attained an intensity much greater than the battery currents ordinarily used in telegraphy: consequently there were serious troubles in the transmission of messages and total interruptions sometimes occurred in both America and Europe. In France communication became impossible about 9 a. m., October 31, and could only be resumed at 4:40 p. m.

The aurora borealis was observed in the United States on the morning of the 31st, and in Ireland and Scotland on the evening of that day. No trace of the aurora was observed in France. A beautiful aurora was observed at Sydney, N. S. W. during the night of October 31–November 1.

The reports from vessels at sea are given elsewhere in a letter from Mr. James Page, of the United States Hydrographic Office, as also a report from the magnetic observatory at Zi-Ka-Wei.

From Table IV, page 496, of the October REVIEW, and page 558 of the November REVIEW, we copy the total number of United States stations reporting thunderstorms and auroras, as follows:

Date.	Thunder-storms.	Auroras.
October 27	5	1
October 28	11	1
October 29	13	2
October 30	71	19
October 31	89	139
November 1	83	18
November 2	38	6
November 3	47	2

STORMS ON THE SOUTHEAST COAST OF CAPE COLONY.

During the early morning of September 13, 1902, a violent storm suddenly struck the southeast coast of Cape Colony and caused great destruction of shipping and life along the shore of Algoa Bay, which is about 400 miles east of Cape Town. The beach facing Port Elizabeth was strewn with the wreckage of 29 sailing vessels and the bodies of over 100 sailors. The storm came absolutely without warning. There were 32 ships at anchor in the harbor under a leaden sky when the approach of a huge wave from the open sea gave the first warning of what was coming.

The study of the storms of south Africa by means of carefully compiled charts of the weather was, we believe, first prosecuted by Mr. Adolph G. Howard, of Cape Town, during 1885–1890. Others had compiled observations at individual localities, but to him is due the credit of preparing a systematic series of daily maps from January, 1885, to December, 1889, showing isobars and winds and the prevailing characteristics of the weather for the region between latitudes 25° and 33° south. These unpublished charts showed him the movements of storms, coming sometimes from the east and sometimes from the west, according to the season. The variations were very much the same as those experienced on our own coasts from South Carolina to Texas. The charts that are now being published daily for Argentina show similar variations in the paths of storms. Similar variations occur in the neighborhood of Australia, all of which merely goes to show that between latitude 20° and 40° in the Southern Hemisphere we have phenomena entirely analogous to those that occur between 20° and 50° in the Northern Hemisphere, so far as concerns the paths of revolving storm centers. On the other hand, we have in the Southern Hemisphere only the feeblest possible Antarctic cold waves, as compared with the very severe Arctic cold waves in the Northern Hemisphere. These latter flow from the Arctic Circle southward to latitude 25° in America, but scarcely as far as latitude 30° in Europe and Asia, while in the Southern Hemisphere they are only feebly represented by the southerly bursters of Australia and the southwest winds of Patagonia and Argentina. The southern point of Africa, Cape Agulhas, is too far from the Antarctic Continent and too well protected by ocean water to be ever reached by a wave colder than those that reach the equally well protected islands of the North Atlantic, such as the Bermudas and the Azores, which are in almost the same latitude north. Storm centers may approach the southern end of Africa from the southeast when the tropical area of high pressure to the eastward is unusually well developed or when the southeast monsoon is unusually strong. Storms may approach from the northwest when the tropical high pressure over the South Atlantic is unusually strong. Storms come down from the north when the interior of Africa is unusually dry and cool, so that it is brought under the influence of the South Atlantic area of high pressure.

DENSITY OF THE ATMOSPHERE UNDER DIFFERENT CONDITIONS.

A correspondent asks the Weather Bureau to make some experimental determination of the density of the air within areas of low pressure, as compared with the density within areas of high pressure. He also asks whether moist air has not a greater specific gravity than dry air, and if moist air under low pressure is heavier than dry air under high pressure.

It is a common idiom to speak of "a heavy atmosphere" when smoke settles down to the ground, or when heavy clouds form low down and threaten to rain; so also we speak of "dull and heavy weather" when we are conscious of a feeling of oppression. This is a poetic usage of the word heavy, in which we attribute to the atmosphere something that really belongs to ourselves. When the smoke falls or the clouds drop rain, it is not the air that is heavy, but the thing that falls. If we experience an oppressive feeling, it is our nervous system that is slightly deranged; the oppression is not a matter of weight or of meteorology, but is a complex physiological phenomenon.

The density of the atmosphere, or its specific gravity, or the weight of a cubic foot of air, increases in proportion as the barometric pressure is greater, and in proportion as the air is drier or free from moisture, assuming that the air remains at the same temperature. Consequently there can be no doubt but that the atmosphere in a region of low pressure and damp air has a smaller specific gravity than in a region of high pressure and dry air. It is not necessary for the Weather Bureau to make any special test of this subject, as its truth is manifest from the experiments made frequently in physical laboratories, in order to determine the properties of gases.

WEATHER NOTES AT WEST CUMMINGTON, MASS.

Mr. William G. Atkins, of West Cummington, Mass., writes, as follows:

Referring to my diary and weather records, which cover a period of forty-five years, I find that the snowfall which gave the most equivalent water occurred on April 20 and 21, 1857, when over 3 feet of heavy wet snow fell on the ground that was previously bare.

1861. February 7 was rainy and snowy; a violent snow squall came about 4 p. m. with a sudden fall in temperature. At 9 p. m. the mercury was at 0° F. and the next morning at 32° below, being a total fall of about 80°. It was 17° below at noon on the 8th of February. On one morning

near that date the mercury registered 20° below, but at noon it was 30° above, or a rise of 50° in five hours.

1875. November 30, the mercury remained below zero all day, the only such record occurring during forty-five years, and, according to Reuben Pierce's "Annals of the Weather," it was the only such record for November for eighty years past.

1880. June 25, the mercury registered 100°.

During the year 1894, three conditions of the weather were recorded, unparalled during the forty-five years.

a. March was very mild and open, scarcely any freezing weather during the first three weeks.

b. The drought of mid-summer was the most severe on record.

c. There was a week of good sleighing during the first half of November.

My record of snowfall shows that the average per winter on the hills in this neighborhood was nearly 8 feet. The winter of 1856–57 gave nearly 12 feet, while the winter of 1899–1900 gave 42 inches. The latter is the smallest on my record, the next larger was 4 feet 2 inches in 1857–58. The winter of 1898–99 gave 141 days of continuous sleighing. The winter of 1899–1900 gave the largest number of days of icy and slippery traveling. The snow blizzard of March 12–14, 1888, the dark day of September 6, 1881, and the extensive disastrous flood of October 4, 1869, are all indelibly impressed upon the mind. During the winter of 1868–69, the lowest extremes of temperature occurred in December and in March.

August is generally a hot, dry month, but in August, 1856, two freshets occurred, caused by heavy rainfalls.

I have seen frosts every month in the year, and killing frosts every month except July.

In the face of these climatic changes we are told that the West and South present much more severe and sudden changes than the climate of New England.

INTERNATIONAL SEISMOLOGICAL ASSOCIATION.

Up to the present time the MONTHLY WEATHER REVIEW has published items bearing on earthquakes, partly because of the general interest in this subject and because of the good records kept by meteorological observers, partly also because we have no journal especially devoted to this subject. At the recent International Conference at Strassburg, Prof. H. F. Reid, of Johns Hopkins University, was present as the official delegate from the United States, and more especially from the United States Geological Survey. He reports that the conference decided upon a form of organization for an international seismological association. The principal features of this association will be the formation of a central bureau for the collection, study, and publication of the reports sent from various countries, and the establishment of local bureaus and local seismological observatories in all parts of the world. A general assembly of delegates will meet at least once in four years. The expenses of the association will be met by contributions from each cooperating nation. A general report as to the instruments best adapted for recording earthquakes will be prepared, but meanwhile each observatory will select its own. It was unanimously decided that in describing earthquakes, and especially in the published official reports of the association, Greenwich mean civil time should be used. Those who are interested in this subject should correspond directly, either with Prof. Harry Fielding Reid of the Johns Hopkins University, Baltimore, Md., or with Professor Dr. Gerland, Director of the Central Seismological Station, Strassburg, Germany.

METEOROLOGY IN HAWAII.

The Governor of the Territory of Hawaii, Hon. G. R. Carter, under date of December 12, 1903, announces that—

The revenues of the territory have been reduced more than one-half, and it will be practically impossible to continue the maintenance of the meteorological service. Much as we should like to prevent a break in the records, yet absolute necessity will force us to discontinue the service. Economy must be practised in every department, and we can not continue the salary even of Mr. Lydecker as territorial meteorologist.

In reply to this communication, the Secretary of Agriculture has written as follows:

In answer to your letter of December 12, 1903, I have the honor to say that my estimates for the support of the Weather Service for the fiscal year beginning July 1, next, provide a sufficient sum to enable us to establish in the Hawaiian Islands a section of the Climate and Crop Service of the Weather Bureau. I am of the opinion that favorable action on these estimates will be taken by Congress. If so, immediately after the first of July next, an official from the Weather Bureau, with an assistant, will be sent to open an observatory at Honolulu. I shall then be glad to have such apparatus as you possess turned over to our representative, which I understand from your communication it is your desire to do. I am of the opinion that a weekly report of the condition of crops should be made and published, the same as is done for each one of our States, and that a monthly publication should be made on the climate of the islands. All this will be undertaken as soon as the means are put at our command.

Notwithstanding the foregoing it is hoped that the Hawaiian government may be able to keep up the meteorological records until the United States Government can relieve it of the work, probably next July. The surveyor general of Hawaii, Mr. E. Wall, is compiling a series of large maps of the archipelago, showing especially the location and elevations of the meteorological stations and other points of scientific interest.

INFLUENCE OF CONTINENTS AND OCEANS ON THE ATMOSPHERE.

In connection with his article in the MONTHLY WEATHER REVIEW, December, 1901, on the physical basis of long-range forecasting, the Editor has been asked how one can express in mathematical language, either analytical or graphic, the character of the different influences exerted on the atmosphere by the land and water, especially the land and water hemispheres there spoken of. Now it is evident that the action of the land differs from that of the ocean in three general respects: thermal, hygrometric, and mechanical, and the following points are to be considered:

1. The atmosphere above the land has a temperature by day higher than that above the water, and the laws expressing this are given in Professor Ferrel's Professional Paper of the Signal Service, No. 13, "Temperature of the Atmosphere and the Earth's Surface."

2. The atmosphere receives far more moisture from the ocean than from the land and the forests on the land, and even more than it does from the snow and ice that cover a portion of the land.

3. This superior content of moisture implies also higher specific heat and a vastly higher content of latent heat, all of which affects its subsequent behavior and phenomena.

4. The movement of the atmosphere over the land with its very irregular surface, is retarded far more than is its movement over the ocean. Even if the land be a smooth plain, a special form of increased resistence is introduced by the fact that during the daytime the heated air rises with a sluggish horizontal movement, and is replaced by descending air having more rapid horizontal movement. This sluggish air is, therefore, an obstacle to the rapidly moving air, not only near the ground, but also at the upper heights to which it rises. There is, therefore, a diurnal periodicity in the horizontal movement of the atmosphere; the latter is at low levels greatest in the middle of the day, but at high levels greatest in the night time. In the process of pushing sluggish air forward the rapidly moving currents convert a part of their kinetic energy into static pressure, and this gives rise to some of the terms in the so-called diurnal oscillation of the barometer. In general, as the air is slightly viscous, we represent the force required for an upper layer to slide over a lower layer by the term for viscosity introduced into the ordinary hydrodynamic equations, whose coefficient is μ (see p. 558, MONTHLY WEATHER REVIEW, December, 1901). Strictly speaking, viscosity is of slight importance, but if we consider the coefficient μ to be itself the summation of several terms, representing, respectively, (*a*) viscosity; (*b*) retardation due to vertical movements caused by orography, producing a mixture of swift upper with slower lower currents; (*c*) retardation due to vertical movements caused by local differences of temperature, producing the same mixture as in *b*; (*d*) retardation due to local differences of moisture; (*e*) that due to local falling rain (since that also is a mass that

has to be moved horizontally); then the sum total, which I call "convection-resistance" due to mixtures, presents an important factor in the turbulent motion of the atmosphere, and may be treated by methods that Boussinesq developed for the study of tumultuous river currents.

5. The reaction between the wind and the ocean by virtue of which surface waters are blown horizontally with a speed of perhaps 1 per cent of the general motion of the adjacent air, introduces a secondary term for the oceanic surface, which does not occur in the land surface, but this is comparatively a minor matter.

6. The superior quantity of latent heat contained in moist air is probably next in importance to the resistance offered by the irregularities of continental or other large masses of land, and its importance may be best evaluated by a study of the quantity of rain, snow, cloud, or fog. The formation of cloud or fog not only evolves latent heat, but entirely alters the coefficient of radiation or absorption of the atmosphere; cloudy air differs in these respects from clear air; the precipitation of rain or snow does even more than this, for it leaves a corresponding amount of latent heat free in the atmosphere, thereby permanently affecting its temperature, and the atmospheric temperature that our equations now have to deal with is that due on the one hand to insolation and its attendant absorption, conduction, and convection, and on the other hand to the latent heat left in the atmosphere by precipitation. The formation of cloud or fog as such, by virtue of the cooling due to expansion, does not materially affect the quantity of heat in the atmosphere. It produces only a temporary local phenomenon, since the expanding air is very soon brought under high pressure, compressed and warmed, before the latent heat, at first evolved, has had time to be lost by radiation or otherwise.

ORIGIN OF THE RARE GASES IN THE EARTH'S ATMOSPHERE.

In a report made by Dr. S. A. Mitchell on the spectroscopic work done by him during the solar eclipse of May 18, 1901, at Sumatra, and published by Columbia University (New York City), there occur the following interesting paragraphs relative to the earth's atmosphere and the spectra of the aurora borealis:

Consequently, it seems that the more volatile gases of terrestrial atmospheric air uncondensed at the temperature of liquid hydrogen, together with hydrogen, helium, neon, and argon, are present in the solar chromosphere, while the evidence in regard to krypton and xenon is inconclusive.

The finding of these gases in the sun and the undoubted presence of free hydrogen in the earth's atmosphere have an importance for cosmical physics that can hardly be overestimated. According to Liveing and Dewar, "if the earth can not retain hydrogen or originate it, then there must be a continued accession of hydrogen to the atmosphere (from interstellar space), and we can hardly resist the conclusion that a similar transfer of other gases must also take place." (Proc. Roy. Soc., vol. 67, p. 468, 1900.) It has been shown by these distinguished physicists, and again by Dewar in his presidential address before the British Association for the Advancement of Science, that these new gases, and particularly the more volatile gases of atmospheric air, play an important part in the spectra of the aurora, of nebulæ, and of the corona. "Of more than a hundred auroral rays observed by Stassano, more than two-thirds of them appear to belong to the more volatile gases of atmospheric air, while the majority of the remainder seem to belong to argon, krypton, and zenon." We are also told by Dewar that of a "list of 339 lines photographed by Humphreys during totality" [this, however, was called the spectrum of the corona, whereas it was the spectrum of the chromosphere] "only 55 do not differ by more than one unit on Ångström's scale from lines measured in the most volatile gases of the atmosphere or in krypton or xenon. It seems rather to the present writer that the great majority of these lines more closely correspond to Fraunhofer lines than to the lines of these rare gases.

These gases may take their origin from the earth itself; in fact, helium and neon are occluded from the waters of the Bath Spring in England. The presence of free hydrogen in the atmosphere can not be explained in this way. It is more likely that hydrogen comes to us in small ionized particles from the sun, being sent hither, as has been shown by Arrhenius, by the pressure of light; and likewise helium and the more volatile gases are present in the atmosphere through being repulsed from the sun by the ionization of small particles of these gases.

It seems, therefore, that the finding of these new gases in the sun's chromosphere is an independent verification of the truth of the theory of Arrhenius, which tells us that particles of matter are being continually scattered throughout the universe, starting from one sun and reaching another, with the result that all bodies of the universe are gradually becoming more and more alike.

THE WEATHER OF THE MONTH.

By Mr. W. B. STOCKMAN, District Forecaster, in charge of Division of Meteorological Records.

PRESSURE.

The distribution of mean atmospheric pressure is graphically shown on Chart IV and the average values and departures from normal are shown in Tables I and VI.

The mean monthly pressure was high from Kentucky, Tennessee, and Georgia northwestward to the coast of the northern and central Pacific districts, and the northern portions of the southern Pacific, with the crest overlying the northern Plateau, and a second area of relatively high but considerably lower mean pressure over the interior of Louisiana, Mississippi, and Alabama. At Boise, Idaho, the mean monthly pressure was 30.40 inches.

The mean pressure was lowest over the northern upper and eastern lower Lakes, northern Middle Atlantic States, and New England, which was the only portion of the country where the mean pressure was below 30.00 inches. The lowest mean monthly barometer reading was 29.90 inches at Eastport, Me.

The mean pressure was below the normal from Minnesota, Iowa, northern Missouri, eastern Kentucky, eastern Tennessee, and northeastern Georgia eastward to the Atlantic Ocean; and above the normal in all other districts.

The greatest minus departures ranged from —.05 to —.10 inch, and occurred in New England, the northern part of the Middle Atlantic States, the lower Lake region, and the northeastern half of the upper Lake region.

Throughout the entire Plateau region the barometer was .10 inch or more above the normal, maximum plus departures occurring over the middle Plateau, and the eastern portion of the north Pacific district, where they ranged from +.20 to +.23 inch.

The mean pressure decreased from that of November 1903, in the Lake regions, New England, Middle Atlantic States, northern portion of the South Atlantic States, eastern parts of the Ohio Valley and Tennessee, upper Mississippi Valley, Missouri Valley, North Dakota, and eastern Montana; and increased over the preceding month in the remaining portions of the United States. The greatest decreases occurred in the northern border States from Minnesota eastward, and were comparatively small, being less than .10 inch, while over the north Pacific, Plateau, and portions of the slope and middle Pacific regions the increase amounted to +.10 to +.28 inch, —the maximum occurring over the northern portions of the northern Plateau and north Pacific districts.

TEMPERATURE OF THE AIR.

The distribution of maximum, minimum, and average surface temperatures is graphically shown by the lines on Chart VI.

The mean temperature was below the normal from the west Gulf States, Missouri Valley, and central North Dakota eastward to the Atlantic Ocean, and in portions of the Plateau regions; and above the normal elsewhere. Over the region east of the Mississippi River the departures were very marked, and averaged from —4.0° to —10.1° per day, the maximum defi-

ciencies being reported from the Ohio Valley northwestward to central Wisconsin. The greatest increases occurred in the slope regions, and the average daily departures (except in a limited area) were, as a rule, not so marked as in the region of deficiency, the maximum departures being reported from eastern and north-central Montana, where they ranged from +9.4° to +10.7° per day.

In the South Atlantic and Gulf States, Florida Peninsula, Ohio Valley and Tennessee, and the Lake region there were but few days when the mean daily temperature was not below the normal. In the Middle Atlantic States it was below the normal on all but 8 days—5th, 13th, and 20–25th, inclusive.

The isotherms of 40°, 50°, and 60° of mean monthly temperature lay considerably to the southward of their position in 1902, as also did that of 30° to the eastward of the Missis- River, and 20° and 10° over the Lake region. The mean monthly temperature was lower than any previous December, as follows: Birmingham, Ala., Sandusky, Ohio, Syracuse, N. Y., Scranton and Harrisburg, Pa., 1°; Binghamton, N. Y., Columbia, S. C., and Modena, Utah, 2°; Lexington, Ky., and Richmond, Va., 3°; Parkersburg, W. Va., 4°; Elkins, W. Va., 5°, and Wytheville, Va., 6°, the decided differences, as a rule, occurring at stations having short records.

The isotherms of 60°, 70°, and 80° of maximum temperature are located to the southward of their position in December, 1902, as also are those of 40°, and 50° over the Lake region and the northern portion of the upper Mississippi Valley.

At Lander, Wyo., the maximum was 4°, and at Carson City 5°, higher than during any preceding December since the establishment of the stations.

The isotherms of minimum temperature generally lay somewhat to the southward of their position in December, 1902. Binghamton, N. Y., a short record station, reports a minimum 6° lower than during any previous December.

The average temperatures for the several geographic districts and the departures from the normal values are shown in the following table:

Average temperatures and departures from normal.

Districts.	Number of stations.	Average temperatures for the current month.	Departures for the current month.	Accumulated departures since January 1.	Average departures since January 1.
		°	°	°	°
New England	8	25.9	− 4.0	− 0.1	0.0
Middle Atlantic	12	31.5	− 4.8	+ 1.1	+ 0.1
South Atlantic	10	42.4	− 5.5	− 4.4	− 0.4
Florida Peninsula *	8	56.1	− 5.0	− 1.6	− 0.1
East Gulf	9	45.7	− 5.2	−14.9	− 1.2
West Gulf	7	49.4	− 2.1	−14.2	− 1.2
Ohio Valley and Tennessee	11	30.6	− 7.6	− 5.8	− 0.5
Lower Lake	8	23.7	− 6.8	+ 2.2	+ 0.2
Upper Lake	10	17.4	− 7.0	+ 5.3	+ 0.4
North Dakota *	8	13.2	+ 0.8	+ 2.3	+ 0.2
Upper Mississippi Valley	11	21.9	− 6.5	− 1.5	− 0.1
Missouri Valley	11	25.9	− 2.8	− 0.8	− 0.1
Northern Slope	7	29.4	+ 4.9	+ 5.1	+ 0.4
Middle Slope	6	36.3	+ 1.4	− 2.7	− 0.2
Southern Slope *	6	43.3	+ 1.6	− 8.5	− 0.7
Southern Plateau *	13	40.4	+ 0.2	− 9.6	− 0.8
Middle Plateau *	8	27.8	+ 0.6	−18.8	− 1.6
Northern Plateau *	12	30.4	+ 0.2	+ 3.0	+ 0.2
North Pacific	7	42.5	+ 0.6	− 0.6	0.0
Middle Pacific	5	50.1	+ 1.4	− 2.3	− 0.2
South Pacific	4	54.2	+ 1.5	+ 0.8	+ 0.1

* Regular Weather Bureau and selected voluntary stations.

In Canada.—Prof. R. F. Stupart says:

The mean temperature of December was higher than the average over the Northwest Territories and the larger portion of British Columbia, and lower than the average over all other parts of the Dominion; the largest positive departures, amounting to nearly 12°, occurred in western Assiniboia and northern Alberta, and the largest negative in the more northern portions of Ontario and Quebec. Near the mountains the mildness of the month was almost phenomenal, with but one really cold spell between the 11th and 15th. In Manitoba and eastward, cold weather was pretty steady throughout the month, with the principal cold dips about the middle of the month, and again in Christmas week when very low temperatures were recorded.

PRECIPITATION.

The distribution of total monthly precipitation is shown on Chart III.

The precipitation for the month was slightly in excess of the normal in western Minnesota, North Dakota, northern and western South Dakota, northeastern and central Wyoming, extreme southern Illinois, western Tennessee, in New York about the eastern ends of Lakes Erie and Ontario, the extreme southeastern parts of Pennsylvania, New Jersey, and Vermont; and between 1 and 2 inches in excess in east-central New Jersey; elsewhere there was a deficiency, and in amounts ranging from 1 to 2 inches in southeastern New England, central New York, about the northwestern part of Lake Michigan, generally in the Middle and South Atlantic and Gulf States, the Ohio Valley and Tennessee, the central Mississippi Valley, and the Pacific and slope regions; 2 to 4 inches in southern Indiana, eastern Tennessee, the northern portion of the east Gulf States, and the Pacific coast districts, and 4 to 6.5 inches in the western portions of Washington, and Oregon, and southwestern California. No precipitation occurred in southeastern California and western Arizona.

No general precipitation occurred on any day during the month in the southern slope, middle and southern Plateau, and southern Pacific districts.

Snow occurred, except near the coast in the South Atlantic and east Gulf States, in Florida, Texas and Oklahoma generally, southern and western Arizona, southern Nevada, southern and western California, and in the western portions of Oregon and Washington. The heaviest snowfalls were reported from the mountain regions of New England and the Middle Atlantic States, the Lake, and the northern and middle Plateau regions, the greatest amounts being reported from Michigan.

At the end of the month appreciable amounts of snow lay on the ground as far south as the central parts of New Jersey and Maryland, extreme southern West Virginia, northeastern Kentucky, southwestern Indiana, central Illinois, southern Iowa, northeastern Nebraska, and generally over the northern and middle slope and Plateau regions.

HAIL.

The following are the dates on which hail fell in the respective States:

Arkansas, 24. California, 17, 31. Georgia, 25. Idaho, 2. Indiana, 1, 15. Indian Territory, 24. Kansas, 12. Maine, 9, 20. Michigan, 12. New York, 13. Oklahoma, 23. Oregon, 10, 13, 17, 18, 19, 20, 22. Rhode Island, 3, 29. Tennessee, 19. Texas, 4. Utah, 11, 17. Virginia, 11, 20. Washington, 10, 14, 16, 22, 26.

SLEET.

The following are the dates on which sleet fell in the respective States:

Alabama, 5, 9. Arizona, 6. Arkansas, 1, 7, 9, 12. California, 17. Connecticut, 29. Georgia, 2, 9, 10, 19, 20. Idaho, 19. Illinois, 3, 11, 12, 13, 19, 20, 23, 27, 30. Indiana, 12, 13, 19, 20, 24, 25. Iowa, 2, 3, 12, 19, 21, 24, 25, 27, 29. Kansas, 8, 9, 12, 19, 23. Kentucky, 12, 13, 19, 24. Louisiana, 1. Maine, 1, 9, 10, 20, 24. Maryland, 9, 20, 24. Massachusetts, 2, 3, 9, 26. Michigan, 19, 20, 24. Minnesota, 2, 18, 19. Mississippi, 1, 9. Missouri, 8, 9, 12, 13, 19, 24, 25. Montana, 2, 24, 31. Nebraska, 9. Nevada, 17. New Hampshire, 9, 10, 20. New Jersey, 2, 3, 9, 24, 25, 26, 27. New York, 3, 4, 5, 13, 19, 20, 21, 24. North Carolina, 2, 3, 9, 10, 19, 20, 24. North Dakota, 2. Ohio, 12, 13, 19, 20, 24. Oregon, 10, 11, 12, 13, 14, 15, 16, 19. Pennsylvania, 2, 20. Rhode Island, 3, 29. South Carolina, 9. South Dakota, 2, 9, 25, 28. Tennessee, 9, 10, 13, 19, 20, 26. Texas, 4, 24. Utah, 11. Vermont, 14, 20, 21. Virginia, 10, 13, 19, 20, 24. Washington, 1, 10, 12, 13, 14, 15, 19, 22, 30. West Virginia, 19, 20. Wisconsin, 19.

Average precipitation and departure from the normal.

Districts.	Number of stations.	Average.		Departure.	
		Current month.	Percentage of normal.	Current month.	Accumulated since Jan. 1.
		Inches.		*Inches.*	*Inches.*
New England	8	2.99	86	−0.5	−4.2
Middle Atlantic	12	2.56	79	−0.7	+0.2
South Atlantic	10	1.85	54	−1.6	−4.1
Florida Peninsula *	8	1.61	64	−0.9	+2.6
East Gulf	9	2.98	65	−1.6	−6.8
West Gulf	7	2.05	61	−1.3	−4.9
Ohio Valley and Tennessee	11	2.13	62	−1.3	−7.7
Lower Lake	8	2.36	82	−0.5	−0.1
Upper Lake	10	1.59	73	−0.6	−0.6
North Dakota *	8	0.96	112	+0.1	−1.7
Upper Mississippi Valley	11	1.11	55	−0.9	−0.7
Missouri Valley	11	0.61	55	−0.5	+3.3
Northern Slope	7	0.28	48	−0.3	+0.2
Middle Slope	6	0.23	25	−0.7	−0.1
Southern Slope *	6	0.15	11	−1.2	−4.8
Southern Plateau *	13	0.05	4	−1.2	−2.3
Middle Plateau *	8	0.23	17	−1.1	−1.7
Northern Plateau *	12	1.14	62	−0.7	−3.2
North Pacific	7	4.33	51	−4.1	−8.8
Middle Pacific	5	2.73	50	−2.7	−5.2
South Pacific	4	0.22	7	−2.8	−4.0

*Regular Weather Bureau and selected voluntary stations.

In Canada.—Professor Stupart says:

The rainfall in British Columbia was very generally about half the average amount and at low levels there was scarcely any snow. In the Northwest Territories the snowfall was light, ranging between one and six inches. In Manitoba there was a little more snow, the fall being between seven inches and one foot, or just about average. On the higher lands of Ontario, immediately west of Lake Huron, and in the Muskoka and Nipissing districts, the snowfall was very heavy, but in other parts of the Province there was much less. The only important rainfall occurred in southern districts on the 12th. The precipitation in Quebec was below average in most districts and was chiefly snow, although rain fell about the 13th and 20th. Near Montreal and in the eastern townships a very heavy snowfall occurred on the 10th, but in more northern and eastern districts the falls, while frequent, were only moderate. In the Maritime Provinces the precipitation was above average and was part rain and part snow, the former predominating. At the close of the month the lower levels of British Columbia and southern Alberta and western Assinniboia were bare of snow, but all other parts of the Dominion were snow covered, the depth being greatest on the higher lands of western and northern Ontario and in the Ottawa Valley, the depth in the former districts being from thirty to sixty inches, and in the latter from twenty to thirty inches. In Quebec the depth was about eighteen inches in the southwest portion and diminished to about ten inches in eastern and northern parts. The greatest depth reported from the Maritime Provinces was a foot at Fredericton, and sleighing was general in all three provinces.

HUMIDITY.

The relative humidity was normal in the Missouri Valley; above normal in the lower Lake region, northern slope district, and northern Plateau, and north Pacific regions, and below the normal in the remaining geographic districts.

The averages by districts appear in the subjoined table:

Average relative humidity and departures from the normal.

Districts.	Average.	Departure from the normal.	Districts.	Average.	Departure from the normal.
	%			%	
New England	73	−3	Missouri Valley	75	0
Middle Atlantic	69	−6	Northern Slope	73	+5
South Atlantic	68	−10	Middle Slope	62	−4
Florida Peninsula	78	−3	Southern Slope	58	−8
East Gulf	68	−9	Southern Plateau	37	−9
West Gulf	67	−7	Middle Plateau	65	−5
Ohio Valley and Tennessee	74	−2	Northern Plateau	83	+3
Lower Lake	81	+3	North Pacific	87	+1
Upper Lake	81	−1	Middle Pacific	76	−5
North Dakota	78	−1	South Pacific	60	−9
Upper Mississippi Valley	76	−2			

SUNSHINE AND CLOUDINESS.

The distribution of sunshine is graphically shown on Chart VII, and the numerical values of average daylight cloudiness, both for individual stations and by geographic districts, appear in Table I.

The average cloudiness was normal in the northern slope and northern Pacific regions; above normal in the Lake region and North Dakota, and below normal in the other geographic districts.

The averages for the various districts, with departures from the normal, are shown in the following table:

Average cloudiness and departures from the normal.

Districts.	Average.	Departure from the normal.	Districts.	Average.	Departure from the normal.
New England	5.6	−0.2	Missouri Valley	5.0	−0.1
Middle Atlantic	5.1	−0.3	Northern Slope	4.6	0.0
South Atlantic	3.6	−1.1	Middle Slope	2.8	−1.2
Florida Peninsula	3.8	−0.8	Southern Slope	3.6	−0.8
East Gulf	3.6	−1.6	Southern Plateau	2.0	−1.0
West Gulf	4.3	−1.0	Middle Plateau	2.7	−2.4
Ohio Valley and Tennessee	5.1	−1.0	Northern Plateau	6.1	−1.0
Lower Lake	8.4	+0.8	North Pacific	7.3	0.0
Upper Lake	7.3	+0.2	Middle Pacific	4.0	−1.4
North Dakota	5.7	+0.5	South Pacific	2.4	−2.0
Upper Mississippi Valley	5.5	−0.2			

WIND.

The maximum wind velocity at each Weather Bureau station for a period of five minutes is given in Table I, which also gives the altitude of Weather Bureau anemometers above ground.

Following are the velocities of 50 miles and over per hour registered during the month:

Maximum wind velocities.

Stations.	Date.	Velocity.	Direction.	Stations.	Date.	Velocity.	Direction.
Block Island, R. I.	3	54	ne.	New York, N. Y.	21	57	nw.
Do	13	55	nw.	Do	26	62	nw.
Do	20	52	s.	North Head, Wash.	1	52	se.
Do	26	50	nw.	Do	15	72	se.
Buffalo, N. Y.	11	51	sw.	Do	19	73	se.
Do	12	65	sw.	Do	20	50	sw.
Do	13	52	w.	Point Reyes Light, Cal.	11	57	nw.
Do	27	56	sw.	Do	16	50	se.
Cheyenne, Wyo.	20	54	nw.	Sand Key, Fla.	26	56	n.
Chicago, Ill	27	52	sw.	Sioux City, Iowa	25	50	nw.
Cleveland, Ohio	12	61	s.	Do	28	50	nw.
Do	26	52	nw.	Syracuse, N. Y.	13	57	s.
Columbus, Ohio	12	53	sw.	Do	21	50	nw.
Do	25	50	nw.	Tatoosh Island, Wash.	3	56	e.
Denver, Colo.	20	54	nw.	Do	4	52	e.
Eastport, Me.	9	54	e.	Do	8	56	ne.
Do	10	55	ne.	Do	15	54	s.
Do	20	60	se.	Do	19	58	s.
Do	21	58	se.	Do	20	56	sw.
Lexington, Ky	12	54	s.	Do	24	62	e.
Do	25	52	w.	Do	25	64	e.
Nantucket, Mass.	20	50	s.	Williston, N. Dak	2	60	nw.
New York, N. Y.	13	61	nw.				

ATMOSPHERIC ELECTRICITY.

Numerical statistics relative to auroras and thunderstorms are given in Table IV, which shows the number of stations from which meteorological reports were received, and the number of such stations reporting thunderstorms (T) and auroras (A) in each State and on each day of the month, respectively.

Thunderstorms.—Reports of 164 thunderstorms were received during the current month as against 386 in 1902 and 889 during the preceding month.

The dates on which the number of reports of thunderstorms for the whole country was most numerous were: 12th, 39; 25th, 24; 26th, 23.

Reports were most numerous from: Kansas and Louisiana, 17; Arkansas, 14; Georgia and Mississippi, 13.

Auroras.—The evenings on which bright moonlight must have interfered with observations of faint auroras are assumed to be the four preceding and following the date of full moon, viz: November 30 to December 8.

In Canada: Thunderstorms were reported from Victoria, 19. Port Simpson, 25. Hamilton, Bermuda, 27.

Auroras were reported from St. John, N. B., 13. Port Arthur, 31. Minnedosa, 21. Swift Current, 1. Calgary, 30. Edmonton, 20. Prince Albert, 21. Battleford, 4, 9, 13, 14, 20, 21.

DESCRIPTION OF TABLES AND CHARTS.

By Mr. W. B. STOCKMAN, Forecast Official, in charge of Division of Meteorological Records.

Table I gives, for about 137 Weather Bureau stations making two observations daily and for about 31 others making only one observation, the data ordinarily needed for climatological studies, viz, the monthly mean pressure, the monthly means and extremes of temperature, the average conditions as to moisture, cloudiness, movement of the wind, and the departures from normals in the case of pressure, temperature, and precipitation, the total depth of snowfall, and the mean wet-bulb temperatures. The altitudes of the instruments above ground are also given.

Table II gives, for about 2,800 stations occupied by voluntary and other cooperating observers, the highest maximum and the lowest minimum temperatures, the mean temperature deduced from the average of all the daily maxima and minima, or other readings, as indicated by the numeral following the name of the station, the total monthly precipitation, and the total depth in inches of any snow that may have fallen. When the spaces in the snow column are left blank it indicates that no snow has fallen, but when it is possible that there may have been snow of which no record has been made, that fact is indicated by leaders, thus (. . . .).

Table III gives, for all stations that make observations at 8 a. m. and 8 p. m., the four component directions and the resultant directions based on these two observations only and without considering the velocity of the wind. The total movement for the whole month, as read from the dial of the Robinson anemometer, is given for each station in Table I. By adding the four components for the stations comprised in any geographical division the average resultant direction for that division can be obtained.

Table IV gives the total number of stations in each State from which meteorological reports of any kind have been received, and the number of such stations reporting thunderstorms (T) and auroras (A) on each day of the current month.

Table V gives a record of rains whose intensity at some period of the storm's continuance equaled or exceeded the following rates:

Duration, minutes	5	10	15	20	25	30	35	40	45	50	60	80	100	120
Rates per hour (ins.)	3.00	1.80	1.40	1.20	1.08	1.00	0.94	0.90	0.86	0.84	0.75	0.60	0.54	0.50

In the northern part of the United States, especially in the colder months of the year, rains of the intensities shown in the above table seldom occur. In all cases where no storm of sufficient intensity to entitle it to a place in the full table has occurred, the greatest rainfall of any single storm has been given, also the greatest hourly fall during that storm.

Table VI gives, for about 30 stations furnished by the Canadian Meteorological Service, Prof. R. F. Stupart, director, the means of pressure and temperature, total precipitation and depth of snowfall, and the respective departures from normal values, except in the case of snowfall.

Table VII gives the heights of rivers referred to zeros of gages; it is prepared by the Forecast Division.

NOTES EXPLANATORY OF THE CHARTS.

Chart I, tracks of centers of high areas, and Chart II, tracks of centers of low areas, are prepared by the Forecast Division. The roman numerals show number and chronological order of highs (Chart I) and lows (Chart II). The figures within the circles show the days of the month; the letters *a* and *p* indicate, respectively, the observations at 8 a. m. and 8 p. m., seventy-fifth meridian time. Within each circle is also given (Chart I) the highest barometric reading and (Chart II) the lowest barometric reading at or near the center at that time, and in both cases as reduced to sea level and standard gravity.

Chart III.—Total precipitation. The scale of shades showing the depth of rainfall is given on the chart itself. For isolated stations the rainfall is given in inches and tenths, when appreciable; otherwise, a "trace" is indicated by a capital T, and no rain at all by 0.0.

Chart IV.—Sea-level pressure and resultant surface winds. The pressures have been reduced to sea level and standard gravity by the method fully described by Prof. Frank H. Bigelow on pages 13–16 of the REVIEW for January, 1902. The pressures have also been further reduced to the mean of the twenty-four hours by the application of a suitable correction, to the mean of the 8 a. m. and 8 p. m. readings, at stations taking two observations daily, and to the 8 a. m. or 8 p. m. observation, respectively, at stations taking but a single observation. The diurnal corrections so applied will be found in Table 27, Volume II, Annual Report of the Chief of Weather Bureau, 1900–1901, pp. 140–164.

The isotherms on the sea-level plane have been constructed by means of the data summarized in chapter 8 of Professor Bigelow's Report on the Barometry of the United States and Canada, which can be found in the Annual Report of the Chief of the Weather Bureau for 1900–1901, Volume II. The correction $t_0 - t$, or temperature on the sea-level plane minus the station temperature, by Table 48 of the Barometry Report, is added to the observed surface temperature to obtain the adopted sea-level temperature.

The wind directions are the computed resultants of observations at 8 a. m. and 8 p. m. daily. The resultant duration is shown by figures attached to each arrow.

Chart V.—Hydrographs for seven principal rivers of the United States, prepared by the Forecast Division.

Chart VI.—Surface temperatures; maximum, minimum, and mean of these. Lines of equal monthly mean temperature in red; lines of equal maximum temperature in black; and lines of equal minimum temperature (dotted) also in black.

Chart VII.—Percentage of sunshine. The average cloudiness at each Weather Bureau station is determined by numerous personal observations during the day. The difference between the observed cloudiness and 100, it is assumed, represents the percentage of sunshine, and the values thus obtained have been used in preparing Chart VII.

Chart VIII. Isobars and isotherms at 10,000 feet. The mean monthly station pressure for each station has been reduced to the 10,000-foot plane by entering Table 53, "Reduction of pressure to the sea level, the 3500 and 10,000-foot planes" pages 789–988, Barometry Report, with the temperature argument t corresponding to θ_2 and correcting the station pressure by the reduction $B_2 - B$ after applying the plateau correction, $C. \Delta \theta. H$, and the corrections for e and ΔA, the argument t being the mean monthly air temperature. This reduction is fully described in Professor Bigelow's Report on the Barometry of the United States and Canada, pages 772 to 786 of the Annual Report of the Chief of Weather Bureau for 1900–1901, Volume II. The reduction for obtaining B_2 may also be found by using gradients from the station pressure to the height of 10,000 feet as set forth on pages 18 and 19, of the MONTHLY WEATHER REVIEW for January 1902.

The isotherms on the 10,000-foot plane have been computed by using the gradients for temperature for each month and station as shown by the Summary Table of Normals, Table 48, Chapter VIII, of Professor Bigelow's Report on the Barometry of the United States and Canada.

Chart IX.—Isobars and isotherms at 3500 feet. The pressure and temperature data entered on this chart are found by the method described for the same data on the 10,000 foot plane.

Chart X.—The total snowfall. This is based on the reports from regular and voluntary observers, and shows the depth of the snowfall during the month in inches. In general, the depth is shown by lines inclosing areas of equal snowfall, but in special cases figures are also given.

Chart XI.—Depth of snow on ground at the end of the month. When there is no snow the last two charts may be replaced by others.

TABLE 1.—*Climatological data for Weather Bureau stations, December, 1903.*

Stations.	Elevation of instruments.			Pressure, in inches.			Temperature of the air, in degrees Fahrenheit.								Mean wet thermometer.	Mean temperature of the dew-point.	Mean relative humidity, per cent.	Precipitation, in inches.			Wind.				Clear days.	Partly cloudy days.	Cloudy days.	Average cloudiness, tenths.	Total snowfall.
	Barometer above sea level, feet.	Thermometers above ground.	Anemometer above ground.	Actual, reduced to mean of 24 hours.	Sea level, reduced to mean of 24 hrs.	Departure from normal.	Mean max. + mean min. ÷ 2.	Departure from normal.	Maximum.	Date.	Mean maximum.	Minimum.	Date.	Mean minimum.	Greatest daily range.				Total.	Departure from normal.	Days with .01, or more.	Total movement, miles.	Prevailing direction.	Maximum velocity. Miles per hour.	Maximum velocity. Direction.	Maximum velocity. Date.					
New England.							**35.9**	**— 4.0**									**73**	**2.99**	**— 0.5**									**5.6**	
Eastport	76	69	82	29.81	29.90	— .08	22.8	— 2.7	51	13	30	— 6	29	15	31	21	17	80	3.26	— 0.7	17	10,955	w.	60	se.	20	9	7	15	6.2	15.3
Portland, Me	103	81	117	29.81	29.94	— .09	23.9	— 3.5	52	13	32	— 3	27	16	29	21	16	75	3.46	0.0	10	8,154	sw.	48	se.	20	13	8	10	5.1	6.8
Concord	298	70	79	29.61	29.94	— .12	22.0	— 4.0	51	20	31	— 8	29	13	34	.....	.....	.....	3.21	+ 0.5	10	4,717	w.	32	ne.	9	13	3	15	5.5	16.1
Northfield	876	16	60	28.96	29.95	— .10	14.8	— 6.6	45	20	26	—20	19	4	41	13	9	77	2.92	+ 0.2	13	5,730	s.	35	sw.	27	3	7	21	7.5	16.1
Boston	125	115	181	29.82	29.96	— .09	29.0	— 2.1	55	13	37	2	27	21	30	25	19	69	2.57	— 0.9	12	9,555	w.	46	se.	20	16	3	12	4.8	10.6
Nantucket	12	43	82	29.96	29.97	— .08	32.7	— 3.7	54	13	39	8	27	26	30	30	24	72	2.97	— 1.3	17	12,025	w.	50	s.	20	9	6	16	6.4	7.8
Block Island	26	11	60	29.98	30.00	— .06	32.4	— 3.8	54	13	39	8	26	26	29	29	24	72	2.45	— 1.2	12	16,449	w.	55	nw.	13	11	9	11	5.2	1.9
Narragansett	.....	10	38	.....	.....	.....	28.0	— 4.8	57	20	38	1	27	18	48	.....	.....	.....	3.56	— 0.2	10	.....	w.	.....	.....	.....	17	4	10	.....	5.0
New Haven	106	117	140	29.88	30.00	— .07	27.4	— 4.8	51	13	35	2	27	20	29	24	19	69	2.53	— 0.9	10	8,119	w.	38	sw.	24	17	5	9	4.3	10.4
Mid. Atlantic States.							**31.5**	**— 4.8**									**69**	**2.56**	**— 0.7**									**5.1**	
Albany	97	102	115	29.90	30.01	— .07	23.3	— 5.3	50	20	31	— 6	19	15	34	21	18	82	1.59	— 1.1	8	5,694	s.	27	w.	13	6	10	15	6.5	12.5
Binghamton	875	79	90	29.02	29.99	— .10	22.6	— 5.9	46	20	31	—12	19	15	43	.....	.....	.....	2.12	— 0.7	16	6,037	w.	38	s.	13	3	15	13	6.9	22.6
New York	314	108	350	29.66	30.02	— .07	30.1	— 4.3	52	13	36	7	27	24	28	27	21	68	2.81	— 0.5	10	12,449	w.	62	nw.	26	10	10	11	5.2	7.7
Harrisburg	374	94	104	29.65	30.07	— .05	28.3	— 6.1	43	24	35	9	27	22	28	25	20	71	1.92	— 1.1	9	6,592	nw.	37	nw.	26	9	17	5	5.0	10.9
Philadelphia	117	168	184	29.93	30.06	— .05	31.8	— 3.7	53	20	38	10	27	25	25	28	21	65	3.29	+ 0.6	9	9,043	nw.	46	nw.	26	16	5	10	4.6	5.2
Scranton	805	111	119	29.13	30.02	— .08	25.8	.....	50	20	34	0	19	18	34	23	18	72	2.59	.....	12	6,803	sw.	33	nw.	22	2	10	19	7.6	16.6
Atlantic City	52	39	48	30.00	30.06	— .04	32.4	— 4.0	52	20	40	12	27	25	28	29	25	75	5.49	+ 1.6	8	6,700	nw.	33	nw.	16	11	12	8	4.9	3.0
Cape May	17	47	51	30.07	30.09	— .02	33.2	— 4.7	50	13	39	14	27	28	28	30	.....	.....	3.52	— 0.3	9	7,153	nw.	35	w.	26	12	12	7	4.4	3.0
Baltimore	123	69	117	29.93	30.06	— .07	33.0	— 4.5	52	13	40	11	27	26	28	28	20	60	2.19	— 1.0	9	6,230	nw.	41	nw.	13	8	13	10	5.2	3.8
Washington	112	59	76	29.96	30.09	— .04	32.2	— 4.0	51	13	40	12	27	24	28	28	22	68	1.89	— 1.1	9	5,264	nw.	40	nw.	26	17	5	9	4.1	1.3
Cape Henry	18	11	58	30.07	30.09	— .03	38.1	— 5.8	62	25	45	16	27	32	23	.....	.....	.....	2.07	— 1.8	7	10,926	nw.	48	nw.	26	14	10	7	4.6	T.
Lynchburg	681	83	88	29.32	30.09	— .05	34.4	— 4.9	52	7	44	14	27	25	33	29	22	63	1.67	— 1.4	5	3,219	nw.	32	nw.	13	14	12	5	4.1	0.2
Norfolk	91	102	111	30.00	30.10	— .03	38.2	— 4.6	61	25	46	17	27	31	25	33	26	65	2.21	— 1.5	6	6,820	n.	34	sw.	20	13	8	10	5.1	T.
Richmond	144	82	90	29.95	30.11	— .03	36.2	.....	56	13	44	16	27	28	28	.....	.....	.....	2.28	.....	5	4,345	s.	26	sw.	20	13	9	9	4.5	0.9
Wytheville	2,293	40	47	27.64	30.11	— .04	28.8	.....	52	24	38	— 2	1	20	33	27	20	75	1.34	.....	8	5,534	w.	30	w.	20	17	2	12	4.5	5.4
S. Atlantic States.							**42.4**	**— 5.5**									**68**	**1.85**	**— 1.6**									**3.6**	
Asheville	2,255	53	75	27.71	30.12	— .04	33.1	— 5.8	59	24	43	10	27	24	33	27	21	67	0.80	— 2.3	5	6,603	nw.	36	nw.	13	15	9	7	4.4	1.0
Charlotte	773	68	76	29.27	30.13	— .03	38.6	— 5.0	58	24	47	18	27	30	28	32	24	59	1.75	— 2.4	7	5,146	sw.	36	w.	10	18	4	9	3.7	T.
Hatteras	11	12	47	30.10	30.11	— .02	42.8	— 5.4	66	25	50	22	27	36	27	40	37	82	3.27	— 2.2	9	11,669	n.	45	sw.	20	14	12	5	3.9	
Raleigh	376	71	79	29.70	30.12	— .03	37.8	— 6.1	60	25	47	14	27	28	32	32	26	69	2.21	— 0.9	6	4,691	n.	26	nw.	26	20	7	4	3.3	0.8
Wilmington	78	82	90	30.03	30.12	— .03	42.6	— 5.7	68	25	53	19	27	32	34	36	30	68	2.35	— 0.6	7	5,967	w.	34	sw.	25	16	9	6	3.5	
Charleston	48	14	92	30.11	30.16	+ .01	45.8	— 5.7	68	13	54	27	27	37	28	39	34	70	1.81	— 1.4	7	7,310	nw.	34	sw.	25	14	12	5	3.7	
Columbia, S. C	351	167	175	29.75	30.14	— .02	42.4	— 5.5	64	24	52	19	27	33	29	36	29	64	1.70	— 1.2	6	7,504	sw.	44	w.	20	17	8	6	3.9	T.
Augusta	180	89	97	29.95	30.15	— .01	42.5	— 5.2	63	25	54	21	27	32	31	36	30	69	1.64	— 1.8	5	4,413	nw.	36	w.	20	18	5	8	3.5	T.
Savannah	65	79	89	30.09	30.16	+ .01	47.6	— 4.8	71	24	57	26	27	38	29	39	33	65	1.34	— 1.9	7	5,658	w.	32	w.	25	17	10	4	3.1	
Jacksonville	43	101	129	30.09	30.14	.00	50.4	— 5.6	76	25	61	26	27	40	30	43	37	70	1.66	— 1.2	6	6,579	nw.	46	s.	20	18	8	5	3.1	
Florida Peninsula.							**61.4**	**— 4.8**									**78**	**0.91**	**— 1.8**									**3.8**	
Jupiter	28	10	48	30.08	30.11	+ .01	62.6	— 4.1	78	14	71	40	3	54	26	57	54	81	0.56	— 2.2	5	8,013	n.	30	sw.	25	13	15	3	4.3	
Key West	22	10	53	30.08	30.09	+ .01	65.9	— 4.1	81	25	70	56	4	62	18	61	58	79	0.71	— 0.9	5	7,636	ne.	40	w.	9	14	10	7	4.1	
Sand Key	24	.....	.....	30.05	30.08	.....	66.8	.....	79	6	71	56	4	63	18	.....	.....	.....	0.31	.....	4	13,497	ne.	56	n.	26	10	15	6	4.6	
Tampa	34	60	67	30.10	30.14	+ .02	55.8	— 6.1	80	24	67	33	27	45	30	48	44	75	1.46	— 0.4	6	4,365	n.	20	se.	12	22	7	2	2.3	
East Gulf States.							**45.7**	**— 5.2**									**68**	**2.98**	**— 1.6**									**3.6**	
Atlanta	1,174	190	216	28.88	30.15	— .01	39.8	— 5.5	62	24	48	16	27	32	28	33	26	62	1.66	— 2.5	6	10,322	nw.	46	nw.	20	17	4	10	3.8	1.2
Macon	370	93	99	29.75	30.16	.00	42.5	.....	63	31	53	21	27	32	32	.....	.....	.....	2.00	.....	6	4,373	nw.	27	nw.	20	18	4	9	3.8	
Pensacola	56	79	96	30.12	30.18	+ .03	49.8	— 4.7	67	25	58	26	27	41	23	.....	.....	.....	3.49	— 0.4	8	7,060	n.	38	nw.	20	21	3	7	3.0	
Birmingham	700	136	143	29.41	30.20	+ .04	42.2	— 6.0	66	24	52	18	26	33	30	.....	.....	.....	1.92	— 3.2	7	5,942	sw.	44	se.	12	19	4	8	3.5	T.
Mobile	57	88	96	30.12	30.18	+ .03	47.4	— 5.0	68	25	57	26	27	38	26	42	36	70	4.40	— 0.1	8	5,246	n.	27	n.	26	21	4	6	3.3	
Montgomery	223	100	112	29.94	30.18	+ .02	44.0	— 5.6	63	25	54	23	27	34	31	39	34	75	2.94	— 1.7	7	4,497	n.	30	nw.	29	19	5	7	3.2	T.
Meridian	375	84	93	29.79	30.20	+ .04	43.0	— 7.5	71	24	55	20	7	31	35	.....	.....	.....	2.73	— 2.6	8	3,907	n.	32	w.	19	19	6	6	3.4	T.
Vicksburg	247	62	74	29.90	30.17	+ .02	47.0	— 3.6	73	24	56	27	27	38	28	39	31	61	2.99	— 2.0	8	5,534	se.	36	nw.	20	17	6	8	3.8	T.
New Orleans	51	88	121	30.13	30.19	+ .06	52.2	— 3.3	76	24	61	33	27	43	25	45	40	73	3.71	— 0.6	7	6,613	n.	40	se.	12	15	7	9	4.3	
West Gulf States.							**49.4**	**— 2.1**									**67**	**2.05**	**— 1.3**									**4.3**	
Shreveport	249	77	84	29.91	30.20	+ .07	47.3	— 2.2	73	24	58	28	13	37	34	40	32	61	3.92	— 0.8	6	5,258	se.	33	nw.	19	18	4	9	4.0	
Fort Smith	457	79	94	29.66	30.15	+ .02	40.6	— 2.2	66	31	52	17	26	29	35	34	28	66	2.64	— 0.5	4	6,463	ne.	43	w.	19	16	7	8	3.6	1.0
Little Rock	357	93	100	29.79	30.18	+ .04	41.6	— 3.4	65	31	51	18	26	32	30	35	27	61	2.60	— 1.7	8	5,731	nw.	39	nw.	12	19	3	9	3.6	0.5
Corpus Christi	20	48	53	30.15	30.17	+ .05	56.8	— 2.5	78	12	64	39	13	49	25	32	48	77	0.79	— 0.5	8	6,523	n.	29	n.	13	7	12	12	5.8	
Fort Worth	670	106	114	29.46	30.19	+ .07	47.4	.....	71	27	59	22	13	35	39	.....	.....	.....	0.30	.....	3	8,112	sw.	38	nw.	12	23	5	3	3.2	
Galveston	54	106	112	30.10	30.16	+ .04	55.0	— 2.1	74	12	60	35	13	50	25	51	48	79	2.27	— 1.7	8	8,938	s.	42	nw.	12	14	10	7	4.3	
Palestine	510	73	79	29.64	30.18	+ .06	50.0	— 1.4	70	28	60	28	14	40	31	42	36	66	1.33	— 2.5	6	6,281	s.	35	se.	12	14	9	8	4.2	
San Antonio	701	80	91	29.42	30.15	+ .05	54.2	— 0.7	77	19	65	33	13	44	33	46	38	62	0.82	— 1.1	8	5,376	se.	32	n.	4	13	7	11	4.8	
Taylor	583	55	63	29.55	30.17	+ .06	50.8	.....	74	23	63	27	13	39	37	.....	.....	.....	1.38	.....	6	6,416	s.	30	n.	4	8	11	12	5.6	
Ohio Val. and Tenn.							**30.6**	**— 7.6**									**74**	**2.13**	**— 1.3**									**5.1**	
Chattanooga	762	106	112	29.36	30.20	+ .04	37.0	— 6.6	60	31	46	14	26	28	33	31	24	63	1.91	— 2.4	8	5,099	w.	41	w.	20	17	4	10	4.0	0.1
Knoxville	1,004	35	88	29.07	30.17	+ .01	34.4	— 5.5	57	24	43	13	27	26	30	29	23	69	1.98	— 2.1	10	5,404	sw.	39	sw.	20	16	4	11	4.5	1.2
Memphis	397	146	154	29.75	30.19	+ .04	39.9	— 3.7	65	24	48	16	26	32	26	36	30	70	4.27	+ 0.1	12	6,977	s.	42	nw.	12	21	3	7	2.9	1.3
Nashville	546	122	134	29.58	30.18	+ .03	34.9	— 6.8	58	31	44	10	26	26	32	30	24	68	3.91	+ 0.2	8	5,104	nw.	42	nw.	25	18	6	7	3.5	0.3
Lexington	989	75	102	29.07	30.16	+ .02	28.5	—10.1	51	12	36	4	26	21	34	.....	.....	.....	1.99	— 1.4	9	8,855	w.	54	s.	12	14	8	9	4.4	6.5
Louisville	525	114	136	29.56	30.16	+ .02	30.8	— 7.6	55	12	39	4	26	23	30	27	21	70	1.58	— 2.3	8	6,628	sw.	48	w.	25	14	9	8	4.4	1.9
Evansville	431	72	82	29.67	30.16	+ .03	39.6	.....	50	23	38	3	26	23	30	.....	.....	.....	3.02	.....	9	5,990	s.	36	nw.	25	13	10	8	4.3	3.1
Indianapolis	822	154	164	29.19	30.11	— .01	24.2	— 8.9	46	23	32	— 4	26	16	28	22	20	84	0.58	— 2.6	9	8,950	s.	40	s.	12	10	12	9	5.0	2.7
Cincinnati	628	152	160	29.42	30.13	.00	27.6	— 9.0	52	12	36	3	26	20	32	25	21	75	1.72	— 1.4	12	5,618	sw.	38	w.	25	13	8	10	5.2	3.6
Columbus	824	173	190	29.18	30.10	— .02	24.6	— 8.7	52	12	32	1	30	17	33	22	20	83	1.71	— 1.2	13	9,166	sw.	53	sw.	12	6	10	15	6.7	4.8
Pittsburg	842	116	123	29.14	30.07	— .04	27.6	— 7.4	54	12	35	6	26	20	37	24	19	73	1.55	— 1.3	14	5,454	nw.	31	sw.	12	4	8	19	7.5	8.5
Parkersburg	638	77	84	29.43	30.14	.00	27.4	— 9.2	52	12	36	5	18	19	38	24	20	76	2.23	— 0.4	13	4,833	sw.	39	nw.	26	3	7	21	8.0	7.3
Elkins	1,940	41	50	27.97	30.10	— .02	24.8	.....	55	12	35	— 2	18	14	51	21	17	79	2.16	.....	17	3,807	w.	32	w.	26	5	13	13	6.5	7.7
Lower Lake Region.							**33.7**	**— 6.8**									**81**	**2.36**	**— 0.5**									**8.4**	
Buffalo	767	178	206	29.12	29.97	— .09	25.4	— 4.4	52	12	31	3	26	20	32	23	19	76	3.70	+ 0.3	28	15,621	w.	65	sw.	12	0	4	27	9.1	25.4
Oswego	335	76	91	29.58	29.96	— .10	23.2	— 6.2	42	29	31	— 6	19	16	34	22	20	85	3.88	+ 0.5	23	10,920	sw.	39	w.	13	0	2	29	9.4	34.2
Rochester	523	81	102	29.38	29.98	— .08	23.9	— 4.7	41	13	30	3	26	17	34	21	18	80	1.83	— 1.1	16	8,628	sw.	31	nw.	22	0	8	23	8.6	16.1
Syracuse	597	97	113	29.31	29.98	— .09	23.2	.....	45	29	30	— 4	19	16	35	.....	.....	.....	1.92	.....	18	11,939	sw.	57	s.	13	1	7	28	7.8	24.0
Erie	713	92	102	29.21	30.01	— .06	25.0	— 7.4	49	12	31	5	26	19	31	23	20	81	2.25	— 1.0	23	10,987	w.	37	sw.	12	1	2	28	8.7	16.9
Cleveland	762	190	201	29.19	30.04	— .05	23.8	— 7.4	47	12	30	3	26	18	37	22	17	76	1.90	— 0.7	19	13,449	sw.	61	s.	12	1	7	23	8.5	14.3
Sandusky	629	62	70	29.34	30.05	— .04	23.3	— 9.2	45	12	29	2	30	17	25	.....	.....	.....	1.78	— 0.7	13	6,872	sw.	35	nw.	29	2	9	20	7.8	7.2
Toledo	628	129	127	29.33	30.04	— .04	22.4	— 8.3	43	23	29	0	14	16	24	21	17	80	1.74	— 0.6	10	8,127	sw.	33	sw.	27	1	11	19	7.4	7.1
Detroit	730	153	193	29.19	30.01	— .06	22.4	— 7.1	39	23	28	1	14	17	24	21	19	87	1.83	— 0.7	12	9,831	sw.	36	sw.	27	2	6	23	8.2	12.3
Upper Lake Region.							**17.4**	**— 7.0**									**81**	**1.59**	**— 0.6**									**7.3**	
Alpena	609	63	80	29.25	29.94	— .08	19.6	— 5.2	36	24	26	— 9	26	13	21	18	16	86	1.07	— 1.4	15	8,842	w.	44	nw.	21	2	9	20	8.0	9.9
Escanaba	612	40	48	29.27	29.97	— .06	15.6	— 5.8	35	19	22	—15	13	9	21	15	13	88	0.88	— 1.0	11	5,620	w.	25	nw.	27	7	4	20	7.1	10.4
Grand Rapids	707	127	165	29.21	30.01	— .04	22.7	— 6.0	40	23	28	3	26	18	20	21	20	88	2.29	— 0.6	22	8,737	sw.	37	sw.	27	0	7	24	8.7	22.1
Houghton	668	66	74	29.18	29.93	— .09	16.6	.....	34	19	22	— 9	13	11	21	.....	.....	.....	4.06	.....	21	5,561	nw.	25	nw.	13	3	3	25	8.6	41.7
Marquette	734	76	116	29.11	29.94	— .08	17.2	— 5.6	36	19	23	—12	13	12	20	15	11	74	2.48	0.0	22	9,401	w.	36	s.	18	3	7	21	8.0	27.9
Port Huron	638	70	120	29.30	30.02	— .04	21.2	— 6.6	38	21	27	— 3	26	15	22	20	17	84	1.87	— 0.4	14	9,606	w.	39	nw.	25	3	8	20	7.9	15.6
Sault Ste. Marie	614	40	61	29.19	29.90	— .10	16.4	— 6.2	34	20	23	—17	26	10	29	15	11	76	1.74	— 0.4	19	7,347	e.	41	nw.	30	3	5	23	8.3	12.9
Chicago	823	241	274	29.14	30.08	— .09	20.0	— 9.3	40	23	28	—13	13	13	32	19	16	84	2.28	— 0.1	11	13,240	w.	52	sw.	27	6	14	11	6.1	18.6
Milwaukee	681	124	142	29.27	30.04	— .02	17.7	— 7.9	41	23	25	—14	13	11	31	16	13	80	1.65	— 0.3	15	8,345	w.	34	sw.	27	9	6	16	6.3	17.4
Green Bay	617	49	86	29.32	30.02	— .02	14.0	— 9.8	37	19	21	—20	13	7	23	12	8	75	0.34	— 1.6	9	7,921	sw.	31	nw.	27	6	9	16	6.6	4.9
Duluth	702	95	116	29.21	30.02	— .03	9.6	— 7.4	32	4	18	—23	13	2	30	8	4	77	1.30	— 0.1	11	7,648	sw.	43	nw.	27	10	12	9	5.2	13.9

TABLE I.—*Climatological data for Weather Bureau stations, December, 1903*—Continued.

Stations.	Elevation of instruments.			Pressure, in inches.			Temperature of the air, in degrees Fahrenheit.										Mean wet thermometer.	Mean temperature of the dew-point.	Mean relative humidity, per cent.	Precipitation, in inches.			Wind.					Clear days.	Partly cloudy days.	Cloudy days.	Average cloudiness, tenths.	Total snowfall.
	Barometer above sea level, feet.	Thermometers above ground.	Anemometer above ground.	Actual, reduced to mean of 24 hours.	Sea level, reduced to mean of 24 hrs.	Departure from normal.	Mean max. + mean min. ÷ 2.	Departure from normal.	Maximum.	Date.	Mean maximum.	Minimum.	Date.	Mean minimum.	Greatest daily range.					Total.	Departure from normal.	Days with .01, or more.	Total movement, miles.	Prevailing direction.	Maximum velocity. Miles per hour.	Maximum velocity. Direction.	Maximum velocity. Date.					
North Dakota.							**13.4**	**+ 0.2**											**78**	**1.01**	**+ 0.3**								**5.7**	
Moorhead	935	54	60	29.02	30.09	+ .01	9.3	− 2.6	35	26	21	−21	13	−2	48	7	6	90	0.90	+ 0.2	13	8,418	nw.	36	nw.	3	10	8	13	5.8	9.0
Bismarck	1,674	16	29	28.24	30.12	+ .04	14.0	− 0.7	42	2	24	−21	13	4	43	11	3	62	1.05	+ 0.4	10	8,751	nw.	49	n.	2	10	9	12	5.6	10.1
Williston	1,875	14	44	28.01	30.07	+ .01	17.0	+ 4.0	46	2	26	−21	13	8	36	16	12	81	1.07	+ 0.4	8	7,984	w.	60	nw.	2	10	10	11	5.7	9.1
Upper Miss. Valley.							**21.9**	**− 0.5**											**76**	**1.11**	**− 0.9**								**5.5**	
Minneapolis		99	208				12.6	− 7.5	35	19	21	−19	13	4	51				0.64	− 0.8	13	9,265	nw.	38	w.	26	10	11	10	....	8.3
St. Paul	857	102	122	29.10	30.05	− .03	12.9	− 5.9	34	19	22	−16	26	4	49	11	8	83	0.65	− 0.6	15	6,895	nw.	30	nw.	28	10	6	15	5.9	6.3
La Crosse	714	71	87	29.25	30.06	− .02	14.8	− 8.8	39	19	24	−21	13	6	37				0.82	− 0.6	11	5,821	s.	27	nw.	21	6	13	12	6.3	9.4
Davenport	606	71	79	29.40	30.08	− .02	20.4	− 7.4	44	6	29	−15	13	12	34	18	14	79	0.78	− 1.0	5	6,461	w.	29	n.	25	7	9	15	6.3	6.9
Des Moines	861	84	99	29.17	30.14	+ .03	22.6	− 4.2	55	31	34	− 9	13	11	42	19	14	71	0.69	− 1.4	3	7,223	nw.	36	nw.	25	5	9	17	7.0	1.6
Dubuque	698	100	117	29.30	30.09	− .01	18.4	− 7.5	46	23	28	−17	26	9	33	16	12	79	0.85	− 1.0	11	5,803	nw.	26	nw.	29	12	9	10	5.5	9.2
Keokuk	614	63	78	29.42	30.11	− .01	24.6	− 5.2	53	31	33	− 7	13	16	35	21	17	74	0.86	− 1.1	5	6,630	nw.	42	nw.	25	12	11	8	4.6	2.2
Cairo	356	87	93	29.78	30.17	+ .02	34.0	− 5.2	57	31	42	9	26	26	31	30	25	72	3.85	+ 0.5	8	6,669	s.	46	nw.	25	13	10	8	4.4	0.6
Springfield, Ill.	644	82	93	29.41	30.12	.00	24.6	− 8.2	48	3	33	− 7	13	16	40	22	18	80	1.50	− 1.2	8	7,976	w.	46	nw.	25	6	14	11	5.8	4.4
Hannibal	534	75	109	29.53	30.12	.00	26.5	− 5.4	58	31	36	− 4	13	17	43				0.93	− 0.7	5	7,561	sw.	42	nw.	25	11	11	9	5.1	2.4
St. Louis	567	208	217	29.50	30.13	.00	29.8	− 5.8	56	31	38	1	13	21	40	26	19	66	1.25	− 1.6	6	9,077	nw.	48	nw.	25	15	9	7	4.2	2.8
Missouri Valley.							**25.9**	**− 2.8**											**75**	**0.61**	**− 0.5**								**5.0**	
Columbia, Mo.	784	11	84	29.27	30.13	+ .01	28.4	− 6.4	62	31	39	− 4	13	18	46				0.87	− 1.0	8	6,949	nw.	43	nw.	25	8	14	9	5.4	4.3
Kansas City	963	78	95	29.10	30.17	+ .05	31.9	0.0	61	31	41	1	13	22	45	27	22	71	1.02	− 0.5	6	6,620	nw.	40	nw.	25	15	8	8	3.9	1.8
Springfield, Mo	1,324	98	104	28.70	30.14	+ .01	34.0	− 4.6	61	31	43	7	13	25	40	30	25	75	1.75	− 0.9	7	8,696	nw.	44	w.	25	21	3	7	3.2	2.0
Topeka		81	89				31.9	− 2.9	61	31	43	3	13	21	46				0.91	0.0	6	6,965	nw.	35	nw.	25	17	9	5	3.8	1.0
Lincoln	1,189	75	84	28.82	30.14	+ .02	28.2	− 2.2	55	31	39	− 1	13	17	46	23	18	68	0.07	− 0.7	3	8,099	nw.	45	nw.	28	13	14	4	4.2	0.7
Omaha	1,105	115	121	28.90	30.14	+ .03	26.0	− 0.7	51	31	36	− 7	13	16	49	22	18	74	0.15	− 0.9	4	7,912	nw.	43	n.	25	8	12	11	5.6	1.5
Valentine	2,598	47	54	27.31	30.13	+ .03	26.6	− 0.6	54	15	40	− 6	12	14	44	22	18	75	0.15	− 0.2	5	8,667	nw.	49	n.	2	12	6	13	5.1	1.1
Sioux City	1,135	96	164	28.82	30.10	− .02	21.4	− 2.7	48	6	32	−13	12	11	55				0.21	− 0.7	5	10,723	nw.	50	nw.	28	8	11	12	5.7	3.7
Pierre	1,572	43	50	28.41	30.16	+ .06	20.4	− 4.3	50	6	30	−19	13	11	46	18	14	76	0.66	+ 0.2	6	5,769	nw.	45	w.	2	10	8	13	5.8	6.4
Huron	1,306	56	67	28.66	30.13	+ .03	14.4	− 4.8	46	6	28	−31	13	1	56	12	10	85	0.60	0.0	7	9,324	nw.	48	nw.	3	8	10	13	6.0	7.4
Yankton	1,233	42	49	28.72	30.10	− .01	21.2	− 1.3	51	26	32	−14	12	10	56				0.37	− 0.4	5	6,509	nw.	36	w.	28	5	14	12	6.2	3.7
Northern Slope.							**29.4**	**+ 4.9**											**73**	**0.28**	**− 0.3**								**4.6**	
Havre	2,505	46	53	27.40	30.12	+ .07	30.0	+ 9.4	63	1	40	−10	14	21	40	27	23	78	0.10	− 0.5	3	9,142	sw.	46	sw.	2	12	12	7	4.9	0.9
Miles City	2,371	42	50	27.51	30.11	+ .01	30.0	+10.7	62	1	38	− 6	•	22	36	26	23	82	0.14	− 0.2	2	5,500	w.	48	w.	2	18	10	3	3.5	1.4
Helena	4,110	88	94	25.91	30.24	+ .11	29.9	+ 4.6	57	1	36	3	12	23	28	26	22	72	0.36	− 0.6	7	5,326	sw.	42	w.	2	11	7	13	5.6	6.8
Kalispell	2,965	45	51	27.09	30.26	+ .19	25.6	.....	48	1	31	10	28	20	18	25	23	86	0.87	.....	9	2,433	w.	37	sw.	2	1	4	26	8.8	7.3
Rapid City	3,234	46	50	26.63	30.11	+ .02	30.0	− 0.2	57	26	41	− 5	12	19	43	25	21	75	0.31	+ 0.1	6	6,749	nw.	38	nw.	2	18	4	9	3.7	3.1
Cheyenne	6,088	56	64	24.01	30.15	+ .06	32.1	+ 3.6	56	31	42	1	12	22	38	24	14	50	0.09	− 0.2	4	10,981	nw.	54	nw.	20	18	10	3	3.3	0.9
Lander	5,372	26	36	24.71	30.30	+ .15	22.3	+ 1.5	61	1	37	−12	12	8	39	17	12	75	0.94	+ 0.2	5	1,949	sw.	34	n.	2	16	12	3	3.2	9.4
North Platte	2,821	43	52	27.14	30.17	+ .07	31.6	+ 4.5	62	26	46	3	13	17	46	24	19	69	0.01	− 0.6	1	6,627	w.	43	nw.	9	15	16	0	3.6	0.2
Middle Slope.							**36.3**	**+ 1.4**											**62**	**0.23**	**− 0.7**								**2.8**	
Denver	5,291	79	151	24.76	30.14	+ .06	36.3	+ 4.3	63	17	49	3	12	23	44	29	22	61	0.23	− 0.4	4	6,712	s.	54	nw.	20	22	8	1	2.7	5.0
Pueblo	4,685	80	86	25.34	30.15	+ .07	34.8	+ 1.1	68	2	52	9	29	18	51	26	14	50	0.04	− 0.5	2	4,672	nw.	48	nw.	18	22	9	0	2.0	0.4
Concordia	1,398	42	47	28.64	30.16	+ .05	33.0	0.0	58	30	45	5	13	21	48	27	22	74	0.12	− 0.4	2	5,096	s.	28	nw.	9	18	9	4	3.4	0.3
Dodge	2,509	44	54	27.48	30.18	+ .08	35.9	+ 3.3	66	30	51	8	14	21	46	27	19	64	0.05	− 0.6	2	7,064	w.	39	se.	11	22	4	5	2.8	T.
Wichita	1,358	78	86	28.69	30.17	+ .06	36.9	− 1.0	64	31	50	9	13	24	41	30	24	67	0.26	− 0.7	2	6,971	nw.	41	n.	12	20	8	3	3.1	
Oklahoma	1,214	79	86	28.83	30.15	+ .04	41.1	+ 1.0	63	31	53	14	13	29	39	33	24	57	0.69	− 1.4	3	8,685	n.	40	n.	12	18	10	3	3.1	
Southern Slope.							**43.7**	**+ 1.8**											**58**	**0.11**	**− 1.2**								**3.6**	
Abilene	1,738	45	54	28.31	30.16	+ .05	48.2	+ 0.7	71	23	60	25	13	36	36	40	34	65	0.22	− 1.3	1	6,671	s.	37	nw.	19	14	8	9	4.0	
Amarillo	3,676	10	49	26.33	30.15	+ .06	39.2	+ 2.9	71	2	53	13	14	25	44	29	18	51	T.	− 1.0	0	9,390	sw.	34	n.	28	20	11	0	3.2	T.
Southern Plateau.							**43.5**	**+ 1.0**											**37**	**0.05**	**− 1.2**								**2.0**	
El Paso	3,762	10	110	26.28	30.13	+ .10	44.4	− 1.7	72	2	58	21	9	30	41	33	20	43	0.01	− 0.5	1	5,909	nw.	48	w.	11	16	10	5	3.6	
Santa Fe	7,013	47	50	23.29	30.21	+ .15	31.8	+ 1.0	56	2	43	8	5	21	29	22	11	46	0.03	− 0.8	2	4,583	ne.	25	nw.	20	31	0	0	0.6	0.3
Flagstaff	6,907	12	25	23.41	30.17	+ .11	29.8	− 0.7	60	2	46	− 1	28	13	50	22	.....	.....	0.10	− 3.0	2	.....	ne.	...	.....	...	25	3	3	1.8	1.0
Phoenix	1,108	50	56	28.92	30.09	+ .05	53.4	+ 1.1	76	1	69	31	23	38	37	41	25	38	0.14	− 0.7	1	2,597	e.	23	ne.	5	24	5	2	2.2	
Yuma	141	16	46	29.93	30.08	+ .03	57.4	+ 1.5	80	1	70	34	23	45	36	45	25	32	T.	− 0.5	0	5,141	n.	30	n.	4	26	3	2	1.1	
Independence	3,910	51	58	26.14	30.19	+ .07	44.2	+ 4.9	66	2	56	24	16	32	31	32	12	28	0.00	− 2.0	0	5,116	nw.	40	w.	31	21	7	3	2.5	
Middle Plateau.							**33.1**	**− 1.4**											**65**	**0.17**	**− 1.2**								**2.7**	
Carson City	4,720	82	92	25.44	30.30	+ .15	32.7	− 1.5	67	1	47	8	7	18	46	28	22	69	0.08	− 2.1	1	3,394	se.	40	sw.	20	21	6	4	2.4	1.0
Winnemucca	4,344	59	70	25.80	30.32	+ .14	30.4	− 0.7	58	1	43	7	7	18	40	26	20	67	0.08	− 1.2	2	5,608	ne.	23	w.	20	18	8	5	3.1	0.2
Modena	5,479	10	43	24.76	30.29	+ .17	27.6	.....	60	1	43	3	6	12	41	21	12	58	0.00	.....	0	6,113	w.	39	sw.	18	27	3	1	1.1	
Salt Lake City	4,366	105	110	25.82	30.33	+ .18	29.6	− 3.2	45	17	37	14	27	22	23	26	22	75	0.51	− 1.1	6	2,777	se.	25	nw.	23	16	5	10	4.2	5.5
Grand Junction	4,608	43	51	25.56	30.27	+ .17	27.6	− 0.2	54	1	42	5	17	13	37	21	13	58	0.02	− 0.4	1	2,513	se.	17	n.	23	23	5	3	2.5	0.3
Northern Plateau.							**31.2**	**− 1.1**											**83**	**1.12**	**− 0.8**								**6.1**	
Baker City	3,471	53	59	26.66	30.36	+ .20	27.5	− 1.0	50	1	34	3	25	21	22	25	22	83	0.68	− 1.1	11	3,807	se.	18	se.	4	10	10	11	5.6	5.1
Boise	2,739	61	68	27.44	30.40	+ .20	32.2	− 1.0	54	1	39	14	30	25	23	29	26	82	0.74	− 1.2	9	2,106	nw.	21	e.	16	15	4	12	4.6	5.1
Lewiston	757	52	61	29.47	30.31	+ .18	36.2	− 1.1	59	1	42	25	6	31	17	...	.....	...	0.96	− 0.4	10	2,681	e.	26	w.	1	9	7	15	5.8	1.9
Pocatello	4,482	46	54	25.67	30.36	+ .17	26.8	+ 0.8	52	1	36	1	27	18	33	23	17	65	0.61	− 0.9	6	5,528	e.	33	sw.	2	18	6	7	3.4	8.7
Spokane	1,929	101	110	28.19	30.31	+ .23	31.3	0.0	54	1	35	20	4	28	22	30	29	91	2.01	− 0.6	12	3,263	nw.	33	w.	1	1	3	27	9.0	5.0
Walla Walla	1,000	65	71	29.21	30.32	+ .20	33.5	− 4.2	56	1	38	21	14	30	25	32	31	93	1.69	− 0.5	11	2,874	s.	26	se.	19	3	5	23	8.3	4.0
N. Pac. Coast Reg.							**42.6**	**+ 0.6**											**87**	**4.35**	**− 4.1**								**7.3**	
North Head	211	11	56	29.94	30.18	+ .15	46.4	+ 2.6	61	8	50	37	2	43	13	45	43	88	5.57	− 4.4	17	11,383	e.	73	se.	19	9	5	17	6.5	
Port Crescent	259	12	29	29.88	30.17	+ .19	40.6	+ 1.2	50	•	45	30	•	36	20	...	.....	...	3.56	− 3.3	16	3,768	e.	16	e.	3	5	12	14	6.7	
Seattle	123	114	151	30.09	30.23	+ .22	42.6	0.0	56	29	47	32	25	38	17	41	39	86	4.14	− 2.0	15	4,412	se.	28	s.	20	4	8	19	7.3	
Tacoma	213	113	120	29.98	30.22	+ .21	41.0	+ 0.1	56	15	46	29	4	36	18	...	.....	...	4.51	− 2.9	13	3,103	sw.	30	sw.	1	2	6	23	8.3	
Tatoosh Island	86	7	57	30.03	30.13	+ .17	45.2	+ 1.9	54	15	48	40	14	43	10	44	42	88	7.96	− 6.5	20	14,910	e.	64	e.	25	6	3	22	7.8	
Portland, Oreg.	154	68	96	30.06	30.23	+ .16	41.0	− 0.3	54	1	46	29	29	36	18	39	36	83	3.14	− 4.6	14	3,860	se.	26	e.	3	5	8	18	7.2	
Roseburg	518	56	67	29.67	30.24	+ .13	40.8	− 1.2	62	15	46	26	4	36	22	39	38	92	1.46	− 5.0	13	1,836	e.	13	s.	15	4	10	17	7.4	
Mid. Pac. Coast Reg.							**50.1**	**+ 1.4**											**76**	**2.73**	**− 2.7**								**4.0**	
Eureka	62	62	80	30.13	30.20	+ .08	49.0	+ 0.4	64	14	55	35	27	43	21	46	44	83	4.03	− 3.2	11	3,623	se.	33	n.	1	15	3	13	4.5	
Mount Tamalpais	2,375	11	18	27.68	30.18	+ .06	49.0	.....	59	1	54	39	17	44	15	42	32	58	2.70	.....	9	14,556	ne.	47	nw.	31	20	4	7	3.3	
Red Bluff	332	50	56	29.84	30.21	+ .07	49.0	+ 2.3	69	8	58	32	7	40	35	44	38	74	3.73	− 1.6	8	3,921	n.	25	n.	2	18	3	10	3.7	
Sacramento	69	106	117	30.12	30.19	+ .05	46.8	− 0.3	59	8	54	31	30	40	22	44	42	86	1.12	− 3.0	5	4,064	se.	26	se.	16	16	6	9	4.3	
San Francisco	155	161	167	30.04	30.21	+ .09	52.4	+ 1.0	66	23	58	42	11	47	19	49	46	80	1.63	− 3.4	6	4,177	n.	26	se.	16	15	8	8	3.9	
Point Reyes Light	490	7	59	29.60	30.12	.....	53.5	+ 3.6	67	4	58	44	17	49	20	...	.....	...	3.15	− 2.2	10	11,046	n.	57	nw.	11	16	7	8	4.1	
Southeast Farallon	30	9	17	30.14	30.17	.....	53.9	.....	60	3	56	48	28	52	8	...	.....	...	1.78	.....	9	9,209	n.	42	nw.	11	15	6	10	4.1	
S. Pac. Coast Reg.							**54.2**	**+ 1.5**											**60**	**0.22**	**− 2.8**								**2.4**	
Fresno	330	67	70	29.82	30.20	+ .07	45.6	− 0.7	64	16	56	27	11	35	30	42	37	77	0.22	− 1.3	1	2,434	nw.	14	nw.	17	17	6	8	3.8	
Los Angeles	338	116	123	29.74	30.11	+ .04	58.2	+ 2.8	80	27	71	37	23	45	34	47	35	51	T.	− 4.0	0	3,700	ne.	17	s.	7	23	5	3	2.1	
San Diego	87	94	102	29.98	30.07	.00	57.8	+ 2.0	75	4	67	44	17	49	25	48	37	57	0.35	− 1.8	2	4,061	ne.	26	ne.	5	26	1	4	1.9	
San Luis Obispo	201	46	48	29.94	30.16	+ .05	55.2	+ 1.8	79	27	70	32	5	41	43	45	34	55	0.32	− 4.2	1	3,482	n.	23	n.	21	24	5	2	1.7	
West Indies.																														
Basseterre	29	41	54	.....	.....	.....	.....	.....	...	...	...	...	...	...	...	...	...	...	.....	.....	...	.....	.....	...	.....	...	...	...	...	...	...
Bridgetown	30	57	65	.....	.....	.....	.....	.....	...	...	...	...	...	...	...	...	...	...	.....	.....	...	.....	.....	...	.....	...	...	...	...	...	...
Cienfuegos	52	62	67	.....	.....	.....	.....	.....	...	...	...	...	...	...	...	...	...	...	.....	.....	...	.....	.....	...	.....	...	...	...	...	...	...
Grand Turk	11	6	20	29.98	29.99	− .02	76.6	.....	87	27	82	64	1	71	18	....	.....	....	3.17	.....	16	.....	ne.	...	.....	...	8	20	3	4.8	
Havana	57	87	55	30.01	30.07	+ .03	69.1	.....	84	25	74	55	4	64	21	...	.....	...	3.07	+ 0.9	16	9,500	ne.	38	e.	23	7	13	11	5.9	
Kingston	286	41	62	.....	.....	.....	.....	.....	...	...	...	...	...	...	...	...	...	...	.....	.....	...	.....	.....	...	.....	...	...	...	...	...	...
Puerto Principe	352	55	90	.....	.....	.....	.....	.....	...	...	...	...	...	...	...	...	...	...	.....	.....	...	.....	.....	...	.....	...	...	...	...	...	...
San Juan	82	48	52	29.86	29.95	− .02	76.4	.....	85	3	82	68	3	71	17	72	70	81	9.48	+ 5.2	20	7,035	e.	32	e.	25	12	15	4	4.4	
Santiago de Cuba	82	46	44	.....	.....	.....	.....	.....	...	...	...	...	...	...	...	...	...	...	.....	.....	...	.....	.....	...	.....	...	...	...	...	...	...

• More than one date.

TABLE II.—*Climatological record of voluntary and other cooperating observers, December, 1903.*

Stations.	Temperature. (Fahrenheit.)			Precipitation.	
	Maximum.	Minimum.	Mean.	Rain and melted snow.	Total depth of snow.
Alabama.	°	°	°	*Ins.*	*Ins.*
Anniston	61	18	38.0	0.69	1.5
Ashville	68	12	39.0	1.71	T.
Benton				2.93	
Bermuda				4.44	T.
Bridgeport				2.74	
Burkeville				3.60	
Calera				2.15	
Camphill	68	16	40.4	3.68	T.
Citronelle	67	23	48.6	5.28	
Clanton	69	20	40.6	3.43	T.
Cordova[f]	70	15	39.0	1.95	
Daphne	71	23	48.6	4.33	
Decatur	62	15	39.0	2.14	
Demopolis				2.98	
Dothan	70	22	47.4	3.59	T.
Eufaula	63	22	40.8	3.97	
Evergreen	69	20	46.3	4.80	T.
Flomaton				3.95	
Florence *a*				3.76	
Florence *b*	64	13	38.4	3.91	T.
Fort Deposit	65	22	42.6	4.86	
Gadsden	65	16	38.3	1.40	
Goodwater	63	17	39.2	3.06	T.
Greensboro	65	21	42.4	3.03	1.0
Greenville				2.46	
Hamilton	64	11	38.1	3.11	T.
Highland Home	65	20	45.4	3.87	
Letohatchie				4.26	
Livingston	68	18	38.0	2.87	
Lock No. 4	65	16	39.2	1.89	
Madison Station	61	16	38.2	3.08	
Maplegrove	65	15	36.2	1.44	
Marion	65	20	39.4	3.43	T.
Milstead				2.78	T.
Newbern	70	17	41.8	3.32	1.0
Notasulga				2.78	
Oneonto	61	13	38.2	2.17	T.
Opelika	65	18	39.6	3.39	
Ozark	68	21	43.8	3.95	
Prattville	63	18	41.2	2.42	T.
Pushmataha	67	19	42.8	3.35	
Riverton	64	12	37.4	4.66	T.
Scottsboro	59	15	37.4	2.02	T.
Selma	64	22	42.2	3.21	T.
Spring Hill	67	27	49.4		
Talladega	67	14	40.4	1.95	0.5
Tallassee				3.06	
Thomasville	67	20	41.8	3.91	
Tuscaloosa	70	19	39.0	1.91	T.
Tuskegee	65	19	44.2	2.29	
Union Springs	66	20	42.2	4.06	
Uniontown	66	16	42.1	2.77	T.
Valleyhead	60	12	35.9	2.24	T.
Verbena				3.17	
Wetumpka	67	20	43.6	3.41	
Alaska.					
Killisnoo	47	25	36.0	5.00	2.5
Orca	44	24	34.5	23.44	26.0
Sitka	49	25	39.8	14.97	0.5
Skagway	47	17	33.6	3.35	
Arizona.					
Agua Caliente	78	25	53.8	0.07	
Allaire Ranch				0.07	
Arizona Canal Co's Dam	82	30	55.6	0.11	
Aztec	82	24	52.3	0.00	
Benson	75	34	52.6	T.	
Blue	67	9	37.1	0.20	2.0
Bowie	71	17	44.0	T.	T.
Casagrande	80	26	51.8	T.	
Champie Camp	81	22	51.1	T.	
Cochise[*1]	69	21	46.0	0.00	
Congress	74	33	54.6	0.06	
Douglas	72	13	44.4	T.	
Dragoon[*1]	84	28	45.1	0.00	
Dudleyville	79	22	47.9	0.76	
Fort Apache	72	6	37.5	0.20	
Fort Defiance	59	−2	24.4	0.02	0.2
Fort Grant	73	24	49.0	0.40	
Fort Huachuca	73	26	46.8	0.18	
Fort Mohave	79	28	51.0	0.00	
Grand Canyon	70	20	42.8	0.00	
Greaterville	70	21	45.5	0.25	
Holbrook	68	4	32.4	0.00	
Jerome	66	26	45.6	0.00	
Kingman	68	23	44.7	0.00	
Maricopa	72	23	48.6	0.20	
Mellen	80	29	50.7	0.00	
Mesa	78	26	53.0	0.20	
Natural Bridge				0.10	
Nogales	77	21	47.6	0.68	
Oracle	67	29	48.8	0.19	
Oro				0.21	
Parker	82	23	50.8	0.00	
Phoenix	76	26	50.8	0.21	
Pinal Ranch				0.86	
Prescott	70	4	33.6	0.00	
St. Johns	64	4	32.2	0.04	0.4
San Carlos	80	18	45.0	0.20	T.
Sentinel[*5]	78	40	57.4	0.00	
Signal[j]	80	18	49.2	0.00	
Superstition				0.21	
Taylor	67	3	54.8	T.	T.
Thatcher	75	16	45.2	0.03	
Tonto	72	24	46.8	0.15	
Tucson	78	21	51.8	0.28	
Upper San Pedro	74	15	44.0	0.04	0.2
Vail[*5]	78	30	58.6	T.	
Walnutgrove				0.01	
Wilcox	72	14	39.2	0.00	
Williams	70	6	35.6	0.00	
Yarnell				0.04	
Young	78	29	38.6	0.15	
Arkansas.					
Alco	60	10	38.7	2.22	1.5
Amity	73	15	42.4	3.55	T.
Arkadelphia	71	16	43.2	2.91	T.
Arkansas City				6.25	
Batesville	60	9	38.5	2.23	
Beebranch	74	14	41.3	3.30	3.0
Blanchard	70	17	43.6	5.05	
Brinkley	67	17	38.8	2.61	1.0
Camden *a*				3.38	
Camden *b*	72	24	44.2	4.01	
Conway	69	16	39.8	1.08	
Corning	64	12	34.7	4.06	0.4
Dallas	67	18	41.8	1.88	T.
Dardanelle				2.08	2.2
De Queen	72	18	42.9	3.65	
Des Arc	70	15	41.8	3.58	1.0
Dodd City	65	9	36.5	2.95	0.5
Dutton	66	8	36.8	6.58	2.0
Elon[j]	69	18	42.8		
Eureka Springs	63	11	37.8	2.99	
Fayetteville				3.45	1.0
Forrest City	66	8	37.7	3.30	2.0
Fulton				1.92	
Hardy	66	10	38.1	2.70	1.5
Heber	67	12	38.7	3.34	2.1
Helena *a*				5.64	
Helena *b*	68	18	40.4	5.63	5.5
Jonesboro	67	10	38.8	4.30	1.0
Lonoke	67	13	40.6	3.50	0.5
Lutherville	65	11	37.4	3.48	1.0
Malvern	65	15	40.7	3.47	0.2
Marvell	68	17	41.6	4.85	0.2
Mossville	58	7	36.7	5.36	T.
Mount Nebo	60	12	38.6	2.87	2.5
New Gascony	70[e]	19[e]	41.4[e]	4.55	1.5
Newport *a*				3.41	0.1
Newport *b*	65	14	39.4	3.37	0.1
Oregon	65	6	36.7	2.68	0.5
Ozark	64	14	37.8	2.87	T.
Paragould	58	14	38.0	3.59	
Perry	68	15	40.3	1.66	2.0
Pinebluff	70	17	39.2	4.28	
Pocahontas	66	12	37.3	4.43	1.0
Pond	64	8	36.2	1.96	1.0
Prescott	68	20	42.8	2.46	T.
Princeton	70	13	41.3	3.13	
Rosadale	71	18	44.0	2.20	
Russellville	64	15	35.8	3.38	0.5
Silversprings	62	9	38.4	2.77	2.0
Spielerville	67	18	40.4	1.76	0.5
Stuttgart	67	14	40.8	3.38	T.
Texarkana	70	19	45.8	1.80	
Warren	72			4.26	
Washington	69	19	44.3	2.12	
Wiggs	68	11	40.0	3.47	0.8
Winslow	59	9	36.8	5.27	3.0
Witts Springs	54	8	33.2	4.40	0.5
California.					
Angiola	69	24	46.0	0.00	
Azusa	81	31	57.3	0.00	
Bagdad	82	31	54.8	0.00	
Bakersfield	70	22	45.0	0.13	
Ballast Point L. H.				0.20	
Barstow	73	29	48.2	0.00	
Bear Valley				4.13	9.0
Berkeley	61	38	49.0	2.19	
Bishop	77	14	41.2	0.00	
Boca[*1]	55	6	26.8	0.50	5.0
Bodie	62	−9	26.8	0.00	
Bowman	65	26	40.8	6.19	22.5
Branscomb	72	29	48.0	9.75	
Brush Creek	63	26	43.3	5.84	
Butte Valley				5.50	23.0
Caliente[*1]	78	28	49.6	0.00	
Campbell	66	29	48.6	0.54	
Campo				0.00	
Cape Mendocino L. H.				5.60	
Cedarville	60	13	31.0	0.42	4.5
Chico	74	28	49.5	2.15	
Cisco[*1]	44	23	33.3	2.80	22.0
Claremont	78	34	55.3	0.00	
Cloverdale	71	30	49.6	3.86	
Colusa	64	30	45.8	2.13	
Corning[*1]	70	32	50.8	3.20	
Coronado	75	40	55.4	0.38	
Crescent City	66	30	48.2	7.62	
Crescent City L. H.				5.14	
Cuyamaca	58	14	37.4	0.16	
Delano[*1]	65	26	43.3	0.11	
Delta[1*]	70	32	48.0	5.07	
Dobbins	78	34	52.0	3.21	
Drytown	62	30	45.0	1.20	
Dunnigan[*1]	64	32	48.8	1.59	
E. Brother L. H.				1.45	
Elcajon	85	29	53.8	0.10	
Electra				1.76	
Elmdale	64	33	50.0	0.50	
Elsinore	86	23	52.8	T.	
Escondido	75	19	47.4	0.05	
Fallbrook	77	31	54.7	0.05	
Folsom City				1.78	
Fordyce Dam				2.86	28.0
Fort Bragg				5.39	
Fort Ross	65	38	49.4	5.09	
Foster				0.12	
Fouts Springs				3.63	
Georgetown	68	33	48.0	2.07	
Gilroy (near)	70	25	49.2	0.24	
Greenville	60	10	36.2	2.94	4.0
Hanford	68	22	44.2	0.15	
Healdsburg	73[d]	28[d]	48.9[d]	4.64	
Hiland Springs				3.84	
Hollister	69	25	48.4	0.20	
Humboldt L. H				4.91	
Idylwild		18		0.00	
Imperial	84	28	53.4	0.00	
Iowa Hill[*1]	67	38	48.8	2.03	
Jamestown	70	28	46.8	1.15	
Jolon				0.42	
Kennedy Gold Mine	68	32	46.0	1.99	
Kernville				0.00	
Kentfield	66	30	47.0	4.11	
King City	78	23	50.2	0.37	
Laguna Valley				0.05	T.
Lamesa				0.28	
Lakeport (near)	61	36	46.6	3.18	
Laporte	55	24	37.8	6.46	32.8
Legrande	78	31	51.1	0.50	
Lemoncove	73	24	47.2	0.27	
Lick Observatory	65	27	47.2	1.39	
Lime Point, L. H				1.80	
Livermore	69	27	48.6	0.59	
Lodi	58	29	45.1	1.01	
Los Gatos	61	36	49.2	0.74	
Magnolia	66	28	46.3	3.70	
Mammoth	80	30	56.6	0.00	
Mare Island L. H				1.68	
Marysville	66	30	47.0	1.97	
Merced	66	16	43.4	0.35	
Mercury				5.20	
Mills College				1.32	
Milo				T.	
Milton (near)	59	36	46.6	0.84	
Modesto	72	32	52.7	0.17	
Mohave	78	25	50.4	0.00	
Mokelumne Hill				1.37	
Montague	52	18	35.2	1.05	
Monterio	78	32	52.4	0.40	
Monterey[*1]	63	31	50.1	0.41	
Mount St. Helena				6.75	
Napa	65	30	48.2	2.46	
Needles	80	35	55.4	0.00	
Nellie				0.01	
Nevada City	71	24	45.2	3.72	
Newcastle	65	29	47.4	2.10	
Newman	62	25	43.8	0.30	
Niles	66	34	50.0	0.78	
Nimshew	64	26	44.7	5.35	T.
North Bloomfield	67	27	44.9	3.80	
North Lakeport				3.35	
North San Juan	74	26	44.0	4.37	
Oakland	64	38	50.8	1.60	
Ontario (near)	76	31	53.6	0.00	
Orleans	64	29	46.2	5.52	
Oroville (near)	71	30	46.9	3.09	
Palermo	64	28	45.6	2.54	
Peachland[*5]	64	32	48.4	6.26	
Piedras Blancas L. H.				0.73	
Pigeon Point L. H				0.65	
Pilot Creek				4.02	2.0
Pine Crest	76	41	60.0	T.	
Pino Grande	68	29	42.9	3.37	4.0
Priest Valley				0.60	
Placerville	64	26	43.4	1.86	
Point Ano Nuevo L. H				0.75	
Point Arena L. H				3.35	
Point Bonita L. H				2.41	
Point Conception L. H				0.00	
Point Fermin L. H				0.00	
Point George L. H				2.44	
Point Hueneme L. H.				0.00	

TABLE II.—*Climatological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
California—Cont'd.	°	°	°	*Ins.*	*Ins.*
Point Lobos	65	44	51.8	0.52	
Point Loma L. H.				0.15	
Point Montara L. H.				1.52	
Point Pinos L. H.				0.76	
Point Sur L. H.				0.50	
Porterville	74	26	46.9	0.23	
Poway				0.06	
Quincy	50	17	34.8	3.72	1.0
Redding	70	29	48.8	4.90	
Redlands	75	35	54.2	0.00	
Reedley	66	23	44.6	0.23	
Represa	64	30	46.6	1.83	
Riovista	61	30	45.4	1.25	
Riverside	78	28	52.6	0.03	
Roe Island L. H.				0.94	
Rohnerville				3.91	
Rosewood	69	24	45.4	2.36	
Sacramento	58	32	45.9	1.43	
Salinas	75	30	51.9	0.39	
Salton	81	29	55.4	0.00	
San Bernardino	82	26	53.7	0.00	
San Jose	68	30	49.2	0.34	
San Leandro	63	34	48.8	1.09	
San Luis L. H.				0.30	
San Mateo*[1]	60	37	48.6	0.86	
San Miguel*[1]	71	19	46.0	0.36	
Santa Barbara	77	41	57.6	T.	
Santa Barbara L. H				0.00	
Santa Clara College	71	27	49.6	0.39	
Santa Cruz	72	30	50.8	0.35	
Santa Cruz L. H.				0.62	
Santa Maria	82	28	55.8	0.16	
Santa Monica	79	38	57.2	0.00	
Santa Paula	92	34	57.4	0.00	
Santa Rosa	69	26	47.4	3.59	
Sausalito	64	42	52.0	2.88	
Shasta	71	32	47.8	4.78	
Sierra Madre	77	41	57.4	0.00	
Sisson	57	11	35.8	2.22	1.0
Sonoma				2.97	
Sonora				0.86	
Stirling City	69	31	47.2	5.20	T.
Stockton	59	29	44.4	0.73	
Storey	65	23	44.8	0.62	
Summerdale	67	24	44.6	2.05	4.0
Susanville	49	15	31.2	0.61	2.0
Tehama*[1]	68	33	49.4	2.87	
Tejon Ranch	74	35	50.2	0.18	
Trinidad L. H				4.64	
Truckee*[1]	62	12	37.7	0.40	4.0
Tulare[c]	74	22	46.0	0.19	
Tustin				0.05	
Ukiah	69	25	46.3	4.55	
Upland	72	35	53.6	0.00	
Upperlake	70	22	44.4	3.71	
Upper Mattole*[1]	68	30	44.6	8.26	
Vacaville*[1]	66	32	47.3	1.84	
Ventura	88	43	60.4	T.	
Visalia	72	23	45.5	0.24	
Volcano	84	25	53.5	0.00	
Wasco	70	23	44.6	T.	
Westpoint				2.30	
Wheatland	69	30	45.0	2.03	
Williams*[5]	60	32	45.2	1.86	
Willits				6.75	
Willow	56	31	47.6	2.14	
Yerba Buena L. H.				1.42	
Yosemite				0.71	
Zenia	68	28	46.3	6.47	
Colorado.					
Alford	58	3	32.3	0.02	0.5
Antelope Springs[j]	44	−13	16.5		
Ashcroft	45	− 8	18.5	0.56	9.0
Blaine	69	6	36.6	0.11	2.0
Boulder	67	8	39.8	0.16	2.5
Boxelder				0.03	
Breckenridge	47	−10	19.2	2.20	33.0
Buenavista				T.	T.
Burlington	64	5	33.6	0.12	1.0
Canyon	67	5	38.0	0.32	3.2
Castlerock	64	− 7	31.1	0.47	6.0
Cheesman	61	− 4	30.2	0.58	8.0
Cheyenne Wells	70	1	34.0	0.13	2.0
Clearview	53	− 9	26.2	0.69	11.0
Collbran	55	− 1	23.2	0.32	4.8
Colorado Springs	60	7	34.0	0.05	0.8
Cripplecreek				0.39	
Durango	61	3	28.4	0.04	0.2
Fort Collins	61	5	32.3	0.07	1.0
Fort Morgan	62	0	30.7	0.15	2.0
Fowler				0.08	0.8
Fox	68	6	33.6	0.10	1.0
Fruita	55	− 1	24.3	0.01	0.1
Garnett	55	−15	18.6	0.05	1.0
Gilman				0.87	13.2
Gleneyre	64	1	32.8	0.17	2.5
Greeley	64	3	32.4	T.	T.
Grover				0.00	
Colorado—Cont'd.					
Gunnison	56	−26	14.3	0.26	3.9
Hamps	65	− 5	31.4	0.14	2.6
Hoehne	68	− 7	30.8	0.20	3.0
Holly	76	5	33.4	0.35	5.5
Holyoke (near)[d]	63	0	30.0	0.00	
Husted	62	− 4	29.4	0.14	2.4
Lake Moraine	45	−10	23.6	0.51	6.7
Lamar	72	8	35.2	0.77	9.0
Laporte				0.00	
Las Animas				0.00	
Leadville (near)	49	− 3	21.4	0.54	5.4
Leroy	60	1	33.6	0.03	0.6
Longs Peak	49	− 4	26.8	0.22	3.5
Mancos	61	3	27.4	0.09	1.1
Marshall Pass				0.93	14.0
Meeker	58	− 5	22.6	0.41	4.7
Montrose				1.18	14.1
Moraine	53	− 1	30.6[f]	0.01	0.3
Pagoda	57	2	26.0	0.57	9.0
Parachute	63	1	26.4	0.06	2.0
Platte Canon				0.45	6.2
Rangely	58	−10	20.0	0.21	3.2
Rockyford	68	3	32.8	0.40	6.0
Rogers Mesa	56	0	25.6	0.30	3.0
Ruby				0.92	14.0
Saguache	54	− 6	22.3	T.	T.
Salida	59	− 7	28.4	0.05	1.1
San Luis	58	−15	26.6	T.	T.
Santa Clara	56	− 2	29.0	0.95	14.0
Silt	58	5	28.0	0.10	1.5
Sugar Loaf	51	− 1	29.1	0.34	5.0
Trinidad	66	7	34.8	0.53	11.0
Vilas				T.	T.
Wagon Wheel	55	−18	16.6	0.30	4.5
Walden	45[d]	− 5[e]	21.3[d]	0.07	1.5
Wallet				0.07	1.0
Waterdale	62	5	33.9	0.18	2.3
Westcliffe	56	−14	25.2	0.25	5.0
Whitepine	39	−11	15.1	0.58	10.3
Wray	63	3	33.6	T.	T.
Yuma				0.09	1.5
Connecticut.					
Bridgeport	51	0	27.5	4.07	12.4
Canton	51	−13	21.1	4.60	19.0
Colchester	52	− 4	26.0	4.82	13.5
Falls Village				3.96	21.5
Hartford	51	− 1	24.6	3.51	11.5
Hawleyville	56	− 5	24.8	4.54	19.0
New London	53	4	28.2	2.23	4.0
North Grosvenor Dale	52	− 8	24.4	4.10	
Norwalk	52	− 6	24.8	4.32	10.5
Southington	51	− 11	24.8	4.10	12.5
South Manchester				3.01	12.0
Storrs	51	− 4	23.4	4.27	14.2
Voluntown	52	− 10	25.8	4.35	6.0
Wallingford				4.48	10.2
Waterbury	50	− 8	24.6	4.37	18.0
West Cornwall	48	− 8	22.2	6.65	34.8
West Simsbury				4.80	17.0
Winsted	48	− 2	22.0		
Delaware.					
Milford	55	10	33.2	4.52	7.5
Millsboro	56	10	32.4	4.20	
Newark	51	9	28.2	4.09	0.2
Seaford	54	11	31.8	3.70	4.0
District of Columbia.					
Distributing Reservoir*[5]	48	15	31.8	1.63	
Receiving Reservoir*[5]	47	14	30.4	1.86	
West Washington	52	12	31.8	2.37	1.7
Florida.					
Apalachicola	74	29	51.8	2.13	
Archer	76	27	49.2	2.31	
Avon Park	85	34	58.2	1.40	
Bartow	80	28	55.2	0.95	
Bonifay	71	24	47.6	3.78	
Brooksville	82	28	54.8	1.50	
Carrabelle	72	29	51.1	2.02	
Clermont	84	34	56.6	0.83	
De Funiak Springs	71	20	47.1	4.63	
Deland	80	25	51.2		
Eustis	81	30	54.6	1.30	
Federal Point	76	29	51.4	1.24	
Fort George*[1]	78	28	52.1		
Fort Meade	84	29	56.0	2.24	
Fort Pierce	82	34	57.5	0.60	
Flamingo	84	43	64.0	0.09	
Gainesville	76	26	50.9	1.49	
Grasmere	79	31	52.2		
Huntington	83	26	50.6	2.01	
Hypoluxo	78	43	63.6	0.98	
Inverness	83	25	50.5	1.55	
Jasper	70	26	47.5	1.34	
Johnstown	73	22	47.2	3.42	
Kissimmee	80	31	55.2	1.51	
Lake City	75	25	50.0	1.78	
Macclenny	78	25	49.5	1.39	
Madison	71	25	49.6	2.67	
Malabar	81	33	57.6	1.12	
Florida—Cont'd.					
Manatee	82	30	56.3	2.35	
Marco	80	43	61.9	0.72	
Merritt Island	79	36	57.6	1.31	
Miami	82	42	66.2	T.	
Micanopy	78	27	50.2	2.20	
Middleburg	78	22	46.8	1.21	
Molino	69	20	46.6	3.75	
Myers	81	38	58.5	1.61	
New Smyrna	82[k]	29[b]	53.6[f]	1.01	
Nocatee	85	30	56.6	2.14	
Ocala	80	26	51.4	1.69	
Orange City	85	24	53.5	1.40	
Orange Home	83	29	53.0	1.15	
Orlando	85	31	53.8	1.00	
Pinemount	72	25	46.7	2.23	
Plant City	83	29	56.2	1.20	
Quincy	78	20	48.0	3.25	
St. Andrews	70	26	47.3	3.34	
St. Augustine	80	28	51.2	1.48	
St. Leo	80	30	54.3	1.32	
Stephensville	75	19	47.7	1.60	
Sumner	76	23	48.6	2.23	
Switzerland	78	27	49.6	1.54	
Tallahassee	71	25	49.2	3.25	
Tarpon Springs	81	29	53.3	1.74	
Wausau	72	23	48.0	3.95	
Wewahitchka	73	27	49.0	3.54	
Georgia.					
Adairsville	60	15	37.2	1.54	
Albany				2.89	
Allapaha	69	22	44.5	1.82	
Alpharetta	58	16	37.3	2.71	2.0
Americus	66	21	43.2	3.63	
Blakely	70[b]	23[c]	44.8[c]	3.20	1.0
Bowersville	60	16	39.3	1.53	1.0
Butler				3.01	
Camak	67	17	40.4	1.27	
Canton				2.02	T.
Carlton				1.83	T.
Clayton				2.17	1.0
Columbus	65[1]	21[d]	43.0[c]	2.65	
Coney	67[d]	18[d]	43.9[d]	3.57	
Covington	60	17	39.2	2.03	2.0
Dahlonega	60	15	37.0	2.28	T.
Dawson	72	21	44.6	3.70	
Douglas	73[c]	24[c]	46.4[c]	3.91	
Dublin				3.01	
Dudley	64	22	44.2	2.66	
Eastman	63[1]	22	42.8[f]	2.57	
Eatonton	64	18	42.4	1.75	1.0
Experiment	62	17	40.8	2.02	1.2
Fitzgerald	70	20	45.6	1.90	
Fleming	75	22	45.7	1.78	
Forsyth	64	18	42.8	2.33	
Gainesville	55	13	37.2	2.41	T.
Gillsville	61	16	39.5	2.18	
Greenbush	58	14	36.8	1.26	T.
Greensboro	63	17	39.2	2.26	1.0
Griffin		18		2.35	1.5
Harrison	65	21	43.2	2.00	
Hawkinsville	68	20	42.0	3.00	
Hephzibah				1.05	T.
Jesup	73	23	46.2	1.85	T.
Lost Mountain	61	15	38.9	2.07	1.2
Louisville	64	21	42.4	2.21	
Lumpkin	65	19	44.9	3.24	
Marshallville	64	21	43.2	2.20	
Milledgeville	63	20	39.9	2.37	
Millen	67	22	44.0	1.29	
Monticello	65	18	41.3	2.71	1.2
Morgan		20		3.91	
Naylor	74	25	45.8	3.60	
Newnan	63	15	38.8	2.05	
Oakdale				1.89	0.1
Oakfield				4.04	
Point Peter	60	15	39.8	1.63	T.
Poulan	70	20	44.6	1.93	
Putnam	67	20	43.8	2.72	
Quitman	70	24	45.8	3.20	
Ramsey	59	12	38.5	1.61	T.
Resaca				1.89	
Rome	62	16	37.4	1.74	
St. Marys	76	21	47.6	1.76	
Statesboro	67	22	46.1	1.85	T.
Talbotton	65	17	42.1	2.76	T.
Thomasville	67	24	48.0	3.17	
Toccoa	64	16	38.8	2.15	2.0
Valona	72	24	46.8	1.84	
Washington	61	18	38.8	1.85	T.
Waverly	77[c]	24[c]	47.0[c]	1.54	
Waycross	78	25	46.8	1.75	
Waynesboro	65	20	41.8	1.48	
Westpoint	68	16	40.0	2.84	T.
Woodbury	64	18	38.0	0.90	0.5
Idaho.					
Albion	56	7	28.2		6.0

TABLE II.—*Climatological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Idaho—Cont'd.	°	°	°	*Ins.*	*Ins.*
American Falls	51	— 5	23.9	0.87	.....
Blackfoot	42	— 5	21.6	0.75	7.5
Blue Lakes	64	13	34.6	0.34	0.5
Burnside	39	2	23.0	0.50	5.0
Chesterfield	48	— 16	20.3	0.42	4.0
Forney	52	— 4	22.8	1.75	16.5
Garnet	52	13	32.6	0.37	.....
Grangeville	58	17	30.8	1.10	11.0
Lake	46	— 6	20.0	1.90	19.0
Lakeview	54	20	32.6	2.11	4.0
Lost River	47	— 5	21.0	0.22	2.5
Meadows	45	— 5	23.1	2.08	12.1
Moscow	60	17	31.4	2.37	8.0
Murray	43	10	27.9	2.60	12.0
Oakley	57	5	30.0	0.39	3.0
Ola	51	1	27.9	1.68	6.3
Orofino	50	17	32.6	2.20	6.0
Payette	53	9	31.3	0.83	2.0
Pollock	59	20	34.5	1.12	1.0
Porthill	48	13	30.5	1.77	9.0
Priest River	45	12	29.2	1.88	5.0
Riddle	57	— 6	25.7	1.00	10.0
St. Maries	49	16	33.2	1.69	4.2
Soldier	41	— 15	15.4	1.00	16.5
Swan Valley [b]	51	— 8	23.0	0.50	5.0
Vernon	44	— 4	22.2	1.18	11.8
Weston	44	— 6	22.4	0.54	6.0
Illinois.					
Albion	48	0	28.2	2.01	2.2
Aledo	45	— 17	21.0	0.66	5.0
Alexander	50	— 7	25.2	1.09	3.5
Antioch	40	— 18	17.0	1.10	11.0
Ashton	42	— 23	17.3	1.80	16.2
Astoria	47	— 10	23.3	2.30	7.0
Aurora	39	— 20	17.8	1.74	13.4
Benton	53	4	31.6	1.92	T.
Bloomington	48	— 11	23.2	2.49	7.5
Bushnell	51	— 10	23.1	.....	.....
Cambridge	43	— 16	20.4	1.36	11.3
Carlinville	51	— 5	26.8	1.75	3.0
Carrollton	48	— 5	26.2	1.40	4.2
Charleston	48	— 6	25.8	2.04	4.1
Chester	.....	.....	.....	1.95	T.
Chicago Heights	.....	.....	.....	2.07	8.0
Cisne	52	1	28.8	2.67	0.5
Coatsburg	50	— 11	23.6	1.17	4.0
Cobden	55	6	32.9	2.82	T.
Decatur	50	— 8	24.8	2.16	3.5
Dixon	55	— 14	22.6	1.16	8.5
Equality	57	4	31.7	2.74	1.1
Fandon	50	— 9	24.3	0.87	1.3
Flora	51	0	27.7	1.92	1.4
Friendgrove	48	2	28.2	2.83	1.1
Galva	44	— 18	20.3	0.92	11.0
Greenville	49	— 2	27.0	1.80	3.4
Griggsville	50	— 9	27.0	1.05	.....
Halfway	53	5	32.4	2.19	T.
Havana	48	— 10	24.5	1.35	3.5
Henry	46	— 18	22.2	1.86	12.5
Hillsboro	50	— 4	26.0	3.05	14.3
Hoopeston	44	— 11	20.8	2.45	14.0
Joliet	41	— 15	19.3	2.18	14.6
Kishwaukee	43	— 22	16.5	1.04	9.9
Knoxville	45	— 14	21.4	0.98	4.3
Lagrange	41	— 18	18.2	2.08	21.3
Laharpe	46	— 9	22.8	0.88	5.0
Lanark	44	— 24	17.6	1.71	16.6
La Salle	52	— 15	25.3	0.33	5.5
Loami	.....	.....	.....	1.32	2.2
McLeansboro	52	4	30.7	2.20	0.2
Martinsville	47	— 6	23.3	1.15	3.5
Mascoutah	55	2	28.3	1.44	3.1
Mattoon	54	— 2	28.6	2.78	4.3
Minonk	45	— 16	21.4	1.47	9.0
Monmouth	48	— 15	21.3	0.66	3.5
Morrison	45	— 22	19.2	1.58	13.3
Morrisonville	49	— 4	25.8	1.82	3.1
Mount Carmel	.....	.....	.....	3.44	7.0
Mount Pulaski	48	— 9	23.8	1.70	4.0
Mount Vernon	52	2	27.9	2.68	0.6
New Burnside	59	3	33.2	3.19	T.
Olney	48	— 1	27.7	2.87	4.2
Ottawa	46	— 13	23.0	1.91	13.1
Palestine	46	— 2	27.1	1.42	1.2
Pana	49	— 5	25.8	1.99	3.5
Paris	48	— 5	23.0	0.29	2.8
Peoria [a]	.....	.....	.....	1.59	8.8
Peoria [b]	47	— 7	24.2	0.95	4.0
Philo	46	— 8	22.6	2.20	6.0
Plumhill	49	2	30.4	1.68	0.5
Pontiac	45	—12	22.7	1.98	10.0
Rantoul	46	—10	23.3	2.62	4.5
Raum	51	3	31.2	3.71	.....
Riley	40	—20	16.6	1.66	14.9
Robinson	49	— 4	27.0	3.29	4.1
Rushville	49	— 8	25.2	0.95	3.5
St. Charles	41	—21	17.4	1.94	15.7
St. John	53	5	31.6	2.05	T.
Shobonier	48	— 3	28.4	1.72	4.0
Streator	45	—17	21.0	1.78	3.2
Sullivan	56	— 7	24.6	2.20	2.0
Sycamore	41	—19	15.9	2.38	23.0
Tilden	52	2	31.0	1.69	1.3
Tiskilwa	42	—19	19.9	1.20	8.4
Tuscola	46	— 8	22.2	2.63	4.6
Urbana	45	— 7	22.2	2.18	3.5
Walnut	43	—19	20.7	1.32	11.7
Winchester	49	— 6	25.2	1.57	4.0
Winnebago	42	—21	16.8	1.68	16.5
Yorkville	40	—21	17.6	1.53	12.0
Zion	44	—21	17.0	1.70	17.0
Indiana.					
Anderson	46	— 6	23.6	1.66	5.8
Angola	40	— 4	22.0	3.27	15.5
Auburn	42	— 5	21.2	2.14	.....
Bloomington	48	— 1	26.8	2.91	8.0
Bluffton	43	— 8	23.2	1.83	8.0
Butlerville	50	0	27.0	2.24	5.5
Cambridge City	45	— 4	21.2	1.76	4.8
Columbus	48	— 2	24.0	1.42	2.0
Connersville	67	— 4	24.1	0.79	3.1
Crawfordsville	45	— 8	21.2	0.61	1.7
Delphi	45	—10	19.8	2.71	11.2
Elkhart	41	— 4	21.1	2.18	21.1
Farmersburg	49	— 4	25.8	2.22	T.
Farmland	45	— 1	24.2	2.10	7.9
Fort Wayne	43[c]	— 5[c]	22.0[c]	.....	3.3
Franklin [d]	49	— 1	26.4	1.89	2.5
Greencastle	45	— 7	24.3	1.80	7.9
Greenfield	46	— 4	24.0	1.88	0.5
Greensburg	46	— 2	25.6	2.12	.....
Hammond	42	—17	18.5	2.57	19.0
Hector	49	— 8	21.2	2.30	7.0
Holland	50	2	29.6	2.47	1.6
Huntington	43	— 9	20.2	2.47	17.0
Jeffersonville	53	5	30.2	1.64	1.0
Kokomo	44	— 9	22.4	3.07	7.5
Lafayette	46	—10	20.5	2.40	7.2
Laporte	41	— 8	20.8	3.21	23.7
Logansport	60	.....	.....	2.90	5.2
Madison [a]	54	2	28.6	1.88	2.8
Madison [b]	.....	.....	.....	1.92	2.5
Marengo	53	5	30.3	2.55	4.5
Marion	44	—10	22.4	2.12	9.5
Markle	45	—10	21.0	2.05	9.5
Mauzy	45	— 5	23.8	2.15	8.5
Moores Hill	49	— 2	25.7	1.79	3.4
Northfield	45	— 9	21.4	2.09	6.0
Paoli	49	0	27.9	1.85	5.5
Princeton	48	2	29.0	2.15	5.0
Rensselaer	43	—11	21.6	3.81	9.0
Richmond	47	— 2	23.9	1.53	0.5
Rockville	45	— 9	22.8	1.64	5.5
Rome	60	3	28.0	2.50	1.5
Salem	50	0	28.4	2.34	10.2
Scottsburg	49	2	29.6	1.67	1.8
Seymour	51	0	26.2	2.10	3.0
Shelbyville [e]	45	— 2	25.8	.....	.....
South Bend	40	—10	18.8	3.30	24.5
Syracuse	42	— 6	21.3	3.02	17.5
Terre Haute	46	— 5	28.1	1.79	6.2
Topeka	40	— 4	18.4	1.92	20.0
Valparaiso	43	—13	20.8	2.56	.....
Veedersburg [e]	45	— 9	24.2	1.23	3.0
Vevay	53	— 5	28.2	1.10	3.5
Vincennes	48	1	26.4	2.62	3.7
Washington	48	1	25.5	2.34	.....
Winamac [e]	43	—12	21.2	.....	.....
Indian Territory.					
Ardmore	70	15	41.9	0.80	
Chickasha	65	9	40.0	0.52	
Claremore	.....	.....	.....	1.50	
Durant	68	19	42.7	0.92	
Fairland	63	11	37.4	2.01	T.
Goodwater	72	15	41.0	2.63	
Hartshorne	.....	.....	.....	1.20	
Healdton	70	10	42.2	0.64	
Holdenville	68	16	41.8	1.15	
Marlow	65	10	39.4	0.39	
Muskogee	67	12	37.4	1.84	
Okmulgee	67	13	40.4	1.55	
Ravia	67	18	43.6	0.60	
Roff	65	10	40.4	0.90	
South McAlester	71	12	44.8	1.40	T.
Tahlequah	64	14	41.6	2.10	
Tulsa	.....	.....	.....	1.09	
Wagoner	66	9	38.0	0.95	
Webbers Falls	66	10	39.2	3.06	T.
Iowa.					
Afton	54	—10	23.4	0.20	2.0
Albia	53	—13	21.3	0.40	4.0
Algona	47	—18	18.2	0.20	1.5
Allerton	55	—12	23.0	0.63	5.0
Alta	47	—20	17.9	0.19	2.0
Amana	48	—15	19.2	0.50	4.4
Ames	49	—13	20.2	0.18	0.5
Atlantic	51	—10	23.0	0.25	2.5
Audubon	49	—13	20.7	0.12	1.5
Baxter	50	—13	21.0	0.10	1.0
Bedford	56	—11	24.1	0.13	.....
Belknap	55	.....	.....	1.16	6.8
Belleplaine	40	—15	16.5	0.59	4.9
Bonaparte	53	— 9	22.1	0.81	.....
Britt	48	—25	15.3	0.36	3.4
Buckingham	.....	.....	.....	0.20	2.8
Burlington	50	— 9	22.7	0.70	.....
Carroll	53	—15	20.4	0.10	1.0
Cedar Rapids	49	—15	17.9	0.68	3.5
Chariton	55	—12	22.3	0.26	T.
Charles City	44	—20	13.3	0.21	4.0
Clarinda	48	—10	23.1	0.17	1.6
Clearlake	42	—21	14.4	0.60	6.0
Clinton	43	—20	19.0	1.00	10.0
College Springs	56	— 9	25.6	0.22	.....
Columbus Junction	47	—15	21.6	0.95	7.0
Corning	54	—11	23.4	0.17	1.8
Corydon	56	—13	22.2	0.26	6.6
Council Bluffs	.....	.....	.....	0.05	0.5
Cumberland	.....	.....	.....	0.20	2.0
Decorah	40	—22	13.7	0.80	9.5
Delaware	43	—21	15.8	0.39	4.2
Denison	48	—13	21.7	0.17	1.8
Dows	48	—17	16.6	0.42	4.2
Earlham	55	—13	21.2	0.05	1.2
Elkader	48	—19	14.8	0.51	9.5
Estherville	47	—22	14.5	0.43	.....
Forest City	49	—26	13.9	0.65	6.5
Fort Dodge	50	—15	20.6	0.02	0.2
Fort Madison	.....	.....	.....	0.64	.....
Galva	49	—17	19.1	0.09	0.9
Gilman	.....	.....	.....	0.10	1.1
Glenwood	54	—10	26.2	0.20	2.0
Grand Meadow	41	—21	14.8	0.75	7.5
Greenfield	50	—13	21.6	0.12	1.3
Grinnell	47	—10	19.8	0.17	1.5
Grinnell (near)	47	—12	19.1	0.15	1.5
Grundy Center	50	—21	17.6	0.24	1.7
Guthrie Center	55	—12	25.5	0.13	.....
Hampton	50	—17	16.6	0.34	3.0
Hanlontown	48	—26	14.5	1.08	3.5
Harlan	47	—12	22.0	0.14	4.0
Hopeville	58	—11	22.6	0.07	0.7
Humboldt	51	—16	19.3	0.22	2.2
Independence	47	—18	16.6	0.63	6.3
Indianola	55	—10	22.4	0.12	1.5
Iowa City	49	—18	18.2	1.27	.....
Iowa Falls	47	—17	15.7	0.45	4.5
Jefferson	.....	.....	.....	0.18	2.0
Keosauqua	.....	— 7	.....	0.66	1.0
Knoxville	56	—10	22.8	0.35	3.5
Lacona	.....	.....	.....	0.80	8.0
Larrabee	49	—21	18.4	0.18	1.9
Leclaire	.....	.....	.....	0.76	8.5
Lemars	46	—15	19.8	0.25	3.0
Lenox	54	—13	22.8	0.08	0.8
Logan	48	.....	.....	0.30	3.0
Maple Valley	.....	.....	.....	0.20	2.0
Maquoketa	46	—22	15.6	0.62	5.0
Marshalltown	49	—13	20.0	0.12	1.4
Mason City	45	—19	16.4	0.53	5.3
Monticello	48	—20	16.4	0.32	9.5
Mountayr	58	—10	23.8	0.62	6.0
Mount Pleasant	50	—14	21.8	0.19	0.2
Mount Vernon	47	—20	17.2	0.85	9.7
New Hampton	41	—24[c]	13.4[b]	0.85	8.5
Newton	48	—13	20.3	0.22	2.5
Northwood	45	—21	16.0	0.75	7.5
Odebolt	50	—15	20.9	0.10	1.2
Onawa	53	— 7	24.0	0.42	4.2
Osage	40	—21	14.3	0.90	9.0
Osceola	58	—11	23.0	0.10	1.0
Oskaloosa	52	—15	19.9	0.34	2.5
Ottumwa	57	— 8	24.5	0.81	4.6
Pacific Junction	49	— 8	23.8	0.17	1.7
Perry	49	—11	21.4	0.30	3.0
Plover	51	—21	16.6	0.17	1.8
Primghar [d]	47	—23	17.0	.....	.....
Redoak	48	— 6	26.0	0.13	1.8
Ridgeway	44	—24	16.2	1.96	12.7
Rockwell City	50	—14	21.3	0.10	1.0
Sac City	49	—16	20.8	0.15	1.5
St. Charles	58	—10	23.6	0.53	1.0
Sibley	39[c]	—27	12.5[c]	0.35	3.5
Sioux Center	46	—21	17.8	0.35	3.5
Spirit Lake	45	—23	16.2	0.50	5.0
Stockport	.....	.....	.....	0.46	1.5
Storm Lake	48	—19	19.2	T.	0.1
Stuart	48	—10	23.0	0.20	2.0
Thurman	51	— 9	24.4	0.52	5.2
Tipton	45	—16	19.6	0.95	8.5
Toledo	48	—14	18.6	0.15	1.5
Villisca	45	—10	24.2	0.23	1.5
Vinton	.....	.....	.....	0.40	4.0
Wapello	45	—12	22.4	0.70	6.5

TABLE II.—*Climatological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Iowa—Cont'd.	°	°	°	*Ins.*	*Ins.*
Washington	51	−19	18.4	0.60	3.5
Washta				0.20	2.0
Waterloo	48	−16	18.7	0.37	2.5
Waukee	54	−11	22.5	0.32	3.0
Waverly	43	−17	15.4	0.55	5.5
Westbend	50	−22	18.1	0.34	3.2
West Union				0.30	3.0
Whitten	46	−20	17.8	0.25	2.5
Wilton Junction	45	−19	19.7	0.43	9.5
Woodburn				0.15	2.0
Kansas.					
Achilles	67	0	31.4	0.10	0.8
Alton	64	7	33.3	T.	T.
Anthony				T.	
Atchison	52	−1	29.6	1.06	2.4
Baker	53	−3	27.4	0.39	1.9
Beloit	59	6	32.7	T.	
Burlington	64	6	34.0	1.14	0.3
Chanute[a]	65	10	36.6	0.12	0.5
Clay Center	60	5	32.7	0.23	
Coffeyville	67	10	38.0	0.60	T.
Colby	67	4	33.6	T.	T.
Columbus	59	10	34.4	1.93	0.9
Cunningham	73	8	37.0	T.	
Dresden	66	4	34.8	T.	T.
Eldorado	70[b]	8	39.8[f]	0.40	T.
Ellinwood	63	8	35.8	0.34	T.
Emporia	62	6	33.6	0.43	T.
Englewood	69	8	37.8	0.07	T.
Enterprise	61	6	34.9	0.22	T.
Eureka				0.54	
Eureka Ranch	70	3	33.4	0.15	T.
Fall River	65	7	34.2	0.77	T.
Farnsworth	72	2	34.4	0.45	4.9
Fort Leavenworth	60	0	31.6	1.72	3.0
Fort Scott	62	7	33.8	1.39	3.9
Frankfort	57	1	28.6	0.40	1.0
Fredonia	62[c]	6[c]	35.2[c]	0.40	
Garden City	69	8	34.8	0.25	1.0
Gove*[1]	70	8	33.2	0.40	4.0
Grenola	65	6	34.0	0.34	
Hanover	57	5	32.2	0.60	
Harrison	60	3	30.6	0.09	0.1
Hays	64	5	33.4	T.	T.
Holton	61	0	29.2	0.49	2.0
Horton	60	−2	29.0	0.24	0.5
Hoxie	68	4	33.6	T.	
Hutchinson	66	5	34.0	0.17	
Independence	65	9	36.2	0.14	T.
Jetmore		5		T.	T.
La Crosse	65	6	34.3	T.	
Lakin	69	7	34.5	0.05	0.8
Lebanon	60[c]	5[c]	31.6[c]	0.00	
Lebo	59	5	32.4	1.12	1.3
Macksville	67	9	36.4	0.12	
McPherson	65	8	33.8	0.36	
Madison	62	4	32.4	0.88	1.0
Manhattan *b*	61	6	31.7	0.40	1.0
Manhattan *c*	63	6	32.4	0.20	T.
Marion	59	3	33.6	0.75	T.
Medicine Lodge	71	11	38.4	0.02	
Minneapolis	60	6	32.8	0.20	
Moran	62	7	33.8	1.16	3.5
Mounthope	65	11	37.5	0.30	
Ness City	68	4	34.2	0.08	1.0
Newton	65	6	35.6	0.40	T.
Norton	64	5	31.6	T.	T.
Norwich	66	10	36.8	0.01	
Oberlin				0.00	
Olathe	60	−2	32.7	1.05	2.0
Oswego	63	9	36.0	1.42	T.
Ottawa	63	3	32.0	0.65	0.6
Paola	62	5	32.6[d]	1.28	2.8
Pleasanton	61	7	33.4	1.97	3.0
Republic	58	4	30.6	0.09	T.
Rome	66	9	37.1	0.10	
Salina	63	6	33.6	0.05	
Sedan	71	8	36.2	0.11	T.
Toronto	65	4	34.1	0.85	
Ulysses	68[d]	7[d]	34.2	0.25	2.5
Valley Falls	61	0	30.4	0.63	3.8
Viroqua	70	3	35.5	0.10	1.0
Wakeeney				0.29	0.2
Wallace	68	5	34.0	0.28	2.8
Walnut	62	8	34.9	1.07	0.5
Wamego*[1]	62	6	31.1	0.35	T.
Winfield	64	9	36.1	0.25	
Kentucky.					
Alpha	58	6	34.2	4.85	1.5
Anchorage	54	2	28.2	1.92	2.3
Bardstown	57	5	31.0	2.75	2.5
Beattyville	54	0	29.0	2.86	4.3
Beaver Dam	54	5	30.2	2.86	2.5
Berea	53	4	32.4	2.59	
Blandville	53	8	32.2	4.68	0.1
Bowling Green	54	3	29.7	3.57	
Burnside	53	8	32.8	3.55	1.0
Cadiz	56	8	33.1	2.61	T.
Calhoun	53	5	31.3	2.39	T.
Catlettsburg	53	7	30.0	1.61	T.
Earlington	56	6	30.6	2.93	0.5
Edmonton	53[j]	4[j]	29.8[j]	3.02	
Eubank	56	4	29.3	3.00	4.5
Falmouth				2.37	0.2
Frankfort	54	6	30.0	2.26	3.0
Franklin	56	8	33.4	4.31	
Greensburg	55	3	28.4	3.08	2.0
Highbridge				2.35	2.5
Hopkinsville	54	6	32.7	4.02	T.
Irvington	54	4	31.0	2.19	2.5
Jackson	58	9	33.6	2.29	
Leitchfield	54	4	30.4	3.38	2.0
Loretto	53	3	29.8	2.40	1.3
Mayfield	54	9	34.3	4.43	0.2
Maysville	51	1	28.5	2.70	7.4
Middlesboro[k]	45	7	27.5	3.62	
Mount Sterling	47	6	27.0	2.55	4.5
Owensboro	52	5	31.2	3.30	1.0
Owenton	48	3	27.9	3.05	9.0
Paducah *b*	56	8	34.0	4.02	T.
Princeton	54	6	34.0	3.95	0.4
St. John	56	5	30.4	2.54	1.6
Scott	50	0	26.8	1.09	2.1
Shelby City	51	3	29.6	2.86	2.8
Shelbyville	49	4	28.4	2.29	10.0
Taylorsville	54	2	28.8	2.49	1.5
Williamsburg	55	10	31.8	3.44	3.3
Williamstown	49	1	28.0	1.96	2.3
Louisiana.					
Abbeville	79	26	48.6	4.46	
Alexandria	74	21	45.9	4.67	
Amite	80	19	46.3	4.85	
Baton Rouge	85	24	48.4	2.95	
Burnside	81	23	50.0	3.94	
Calhoun	75[j]			3.42	
Cameron	68	31	51.3	3.18	
Caspiana	79	17	48.0	5.04	
Clinton	78	25	44.9	5.23	
Collinston	76	18	43.3	4.94	T.
Covington	76	21	46.6	3.75	
Donaldsonville	82	25	51.0	5.11	
Emilie	74	24	48.9	4.62	
Franklin	79	25	51.2	4.15	
Grand Coteau	72	25	49.7	4.46	
Hammond	74	20	47.3	3.62	
Houma	75	21	47.9	3.12	
Jennings	78	26	49.2	2.54	
Lafayette	78	24	48.6	3.36	
Lake Charles	78	29	51.6	3.17	
Lake Providence	74	20	47.0	3.81	
Lakeside	79	28	50.2	2.01	
Lawrence	82[c]	30	50.3[c]	2.45	
Leesville	83	25	48.0	4.82	
Libertyhill	74	20	47.8	5.34	
Logansport				4.34	
Melville	82	20	48.0	4.46	
Minden	72[c]	19[b]	42.6[c]	5.55	
Monroe	75	20[d]	47.2[b]	4.17	
New Iberia	77	30	51.4	3.30	
Opelousas	79	23	47.8	3.36	
Oxford	76	20	47.8	4.24	
Plain Dealing	70	18	44.8	3.85	
Port Eads	80	40	55.7	2.43	
Rayne	84	20	47.8	3.80	
Reserve				4.37	
Ruston	70	22	46.2	5.02	
St. Francisville	73[f]	20[c]	47.4[f]		
Schriever	84[d]	23	49.1	3.54	
Southern University				3.89	
Sugar Experiment Station	72	29	50.0	3.89	
Sugartown	78	27	49.6	3.61	
Venice	75	28	50.6	1.52	
Wallace	79	23	49.4	4.82	
Maine.					
Bar Harbor	50	−5	23.2	3.35	7.5
Belfast	51	−8	19.9	4.26	12.0
Chesuncook				2.35	19.0
Cornish	47	−7	21.2	3.19	17.0
Danforth				3.16	8.0
Fairfield	50	−10	19.8	2.70	13.0
Farmington	47	−18	17.2	4.19	21.5
Fort Fairfield	45[d]	−15[d]	13.3[d]	1.55	7.0
Gardiner	50	−8	20.5	3.56	8.0
Houlton	42	−12	17.4	2.00	22.0
Lewiston	48	−4	21.4	4.13	15.6
Mattawamkeag				2.67	
Mayfield	44	−13	16.8	3.06	12.0
Millinocket	49	−12	16.8	3.64	15.5
North Bridgton	47	−10	20.6	3.36	20.0
Orono	50	−10	20.0	3.14	9.2
Patten	49	−20	16.9	3.40	
Rumford Falls	48	−14	18.8	3.63	16.0
South Lagrange	49	−14	17.8	2.51	8.7
The Forks				2.97	22.0
Vanburen	44	−24	10.6	2.51	10.0
Vanceboro	48	−12	16.6	0.39	7.5
Winslow				2.98	12.0
Maryland.					
Annapolis	49	11	33.2	3.40	1.0
Bachmans Valley	44	8	27.0	4.20	12.5
Boettcherville	56	8	29.4	0.36	2.5
Boonsboro	49	8	29.8	1.19	3.5
Cambridge	52	12	32.8	4.27	5.5
Charlotte Hall	53[b]	9[b]	30.7[b]		
Chase	52[c]	10[c]	30.5[c]	3.36	5.2
Cheltenham	52	7	30.7	2.25	1.0
Chestertown	57	12	31.6	3.47	3.9
Chewsville	47	7	27.2	0.41	3.5
Clearspring	46	8	27.6	1.49	4.0
Coleman	53	10	32.1	3.76	5.5
Collegepark	51	6	30.0		
Colora				3.61	7.3
Cumberland				0.50	1.0
Darlington	50	9	29.3	3.51	7.0
Deerpark	52	−5	21.3	1.77	17.7
Denton		10		3.39	9.5
Easton	52	11	33.3	2.55	3.9
Fallston	49	7	29.6	2.86	5.5
Frederick	50	11	30.8	1.58	5.0
Grantsville	46	−3	21.9	1.83	10.5
Greatfalls	48	8	30.1	0.88	
Greenspring Furnace	47	6	28.8	1.31	2.0
Hancock	55	8	30.1	0.71	1.0
Harney				2.00	5.5
Jewell	53	10	32.5	2.48	2.0
Johns Hopkins Hospital	52	11	33.1	2.86	
Laurel	49	9	29.4	2.33	5.0
Mount St. Marys College	45	9	30.3	1.38	9.6
New Market	44	8	29.2	1.94	10.2
Oakland	60	−9	23.0		
Pocomoke City				2.71	2.2
Princess Anne	55	13	32.9	3.01	3.5
Sharpsburg	49	10	30.9	0.72	
Solomons	53	13	34.0	2.04	2.0
Sudlersville	52	11	31.6	3.30	
Takoma Park	50	7	29.5	2.27	
Van Bibber	49	10	30.6	3.22	
Westernport	54	6	27.4	0.32	3.2
Woodstock	51	12	32.2	2.39	3.9
Massachusetts.					
Amherst	52	−10	22.1	3.95	12.0
Bedford	52	−5	24.6	2.67	9.0
Bluehill (summit)	51	−4	24.8	3.05	14.0
Cambridge	52	−4	27.3	3.25	
Chestnuthill	53	−6	27.0	3.01	7.0
Cohasset				2.25	
Concord	53	−10	23.6	2.72	9.6
East Templeton*[1]	46	−2	21.9	3.72	11.8
Fall River	55	3	29.0	3.32	7.0
Fitchburg *a**[1]	48	−2	23.6	3.88	13.5
Fitchburg *b*	51	−5	23.6	3.26	13.2
Framingham	54	−12	25.2	3.05	9.5
Groton	50	−6	22.3	2.94	15.0
Hyannis				3.17	4.2
Jefferson				4.27	15.2
Lawrence	52	−14	24.2	2.64	12.5
Leominster				2.53	12.8
Lowell *a*	51	−6	26.1	3.01	
Lowell *b*	53	−6	25.5		
Ludlow Center	46	−17	18.2	2.29	16.0
Middleboro	55	−10	26.0	3.35	5.5
Monson	51	−8	23.2	4.14	15.5
New Bedford	54	0	27.0	3.35	5.0
Pittsfield				3.33	16.0
Plymouth				4.01	4.5
Princeton				3.71	13.0
Provincetown	52	6	31.8	3.22	3.5
Salem				2.43	13.0
Somerset*[1]	54	−6	26.2	5.18	9.6
Sterling				3.84	11.5
Taunton	52	−11	25.0	3.70	4.2
Webster				3.29	11.8
Westboro	52	−12	26.2	3.41	10.2
Weston	53	−6	24.4	2.63	9.9
Williamstown	50	−5	21.7	2.19	13.0
Winchendon				3.48	17.5
Worcester	51	−2	24.9	2.30	14.8
Michigan.					
Adrian	42	−2	22.6		
Agricultural College	41	−9	19.7	1.75	17.5
Allegan	40[f]	−1[f]	20.2[f]	2.92	29.0
Alma	39	−6	19.6	1.47	15.5
Ann Arbor	40	−2	20.9	2.39	10.4
Arbela	40	−5	20.8	1.27	8.9
Ball Mountain	40	−4	20.4	1.93	12.5
Baraga	34	−16	16.0		
Battlecreek	39	−4	19.2	2.65	20.0
Bay City	40	1	21.1	1.45	9.0
Benzonia	35	−3	20.1	2.60	26.0
Berlin	40	−4	20.0	2.13	20.4
Big Rapids	38	−6	17.8	2.85	18.5
Birmingham	39[f]	−3	21.0[c]	1.12	11.2
Calumet	36	−12	15.4	4.12	54.2
Cassopolis	39	−3	22.0	3.24	11.0

TABLE II.—*Climatological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Michigan—Cont'd.	°	°	°	*Ins.*	*Ins.*
Charlevoix				2.30	23.0
Chatham	35	−13	15.0	1.99	19.4
Cheboygan	35	−11	18.0	1.40	14.0
Clinton	40	− 4	21.5	1.96	11.0
Coldwater	39	− 2	20.2	2.00	15.0
Deerpark	35	−11	17.5	2.65	19.5
Dundee	40	− 1	21.5	2.09	.....
East Tawas	39	− 8	20.2	1.91	12.0
Eloise	38	− 1	21.8	1.99	8.6
Ewen	31	−22	9.2	0.55	5.5
Fennville	38	1	22.4	4.26	34.5
Fitchburg	39	− 5	20.2	2.82	24.0
Flint	40	− 7	20.6	1.37	8.5
Frankfort				0.90	9.0
Gaylord	38[c]	−19[c]	20.2[c]	2.01	17.9
Grand Haven	39	5	23.8	1.37	10.0
Grand Marais	37[f]	− 3[d]	21.6[e]	2.31	25.0
Grape	39[d]	− 3[d]	21.0[d]	1.84	7.5
Grayling	35	−12	17.0	3.10	31.0
Hagar	40	− 2	22.8	4.85	36.7
Harbor Beach	39	− 5	20.2	1.32	13.2
Harrison	35[c]	− 6[c]	15.7[c]	2.60	26.0
Harrisville	38	−11	18.8	2.22	22.2
Hart	39	3	20.0	4.40	43.0
Hastings	41	− 8	20.0	1.98	15.9
Hayes	38	− 5	19.4	1.75	17.5
Highland Station				1.82	17.0
Hillsdale	40	− 4	19.0	2.64	13.0
Humboldt	31	−20	9.2	1.10	11.0
Ionia[1]	40	− 6	21.3	.....	.....
Iron Mountain	33	−20	12.6	0.84	8.0
Iron River	33	−23	8.3	0.95	6.0
Ironwood	30	−25	9.1	4.40	44.0
Ishpeming	32	−22	13.0	1.55	15.0
Jackson	41	− 3	21.8	2.07	17.0
Jeddo	38	− 5	20.2	2.10	15.5
Kalamazoo	39[c]	− 2[c]	20.2[c]	5.71	54.0
Lake City	31	− 9	16.4	1.55	15.5
Lansing	41	− 2	20.8	2.06	13.0
Lapeer	41	− 6	20.8	.....	.....
Ludington[j]	38	− 5	20.3	3.16	31.6
Mackinac Island	34	− 9	19.9	2.56	25.6
Mackinaw	34	−12	19.3	3.57	35.7
Mancelona	32	− 6	17.8	5.20	52.0
Manistee[k]	38	1	20.4	3.45	34.5
Manistique[k]	37	−11	19.2	1.20	10.0
Marine City	38[l]	− 4	21.0[c]	2.60	14.9
Menominee	36	−16	15.3	0.57	5.7
Midland		5	.....	1.37	13.0
Mio	35	−22	16.3	1.15	11.4
Montague	38	3	22.5	3.60	26.5
Mount Pleasant	44[c]	−11[c]	21.7[c]	1.55	15.5
Muskegon	47	1	23.0	3.60	31.0
Old Mission	35	− 2	20.2	1.33	.....
Olivet	38	− 4	20.4	2.48	19.3
Omer	40			1.00	10.0
Onaway	38	−16	18.0	.....	.....
Ovid	39	− 5	19.8	0.98	9.0
Owosso	41	− 4	19.8	0.70	7.0
Petoskey	35	−10	20.0	2.68	25.1
Plymouth		6	.....	0.45	2.5
Port Austin	40	− 2	20.2	1.15	11.5
Reed City	37[c]	−13[c]	18.8[c]	1.37	10.0
Roscommon	35	−10	16.9	1.40	14.0
Saginaw (W. S.)	42	− 3	22.2	1.76	12.5
St. Ignace	38	−18	20.4	1.45	12.0
St. Johns[c]	39	− 2	20.8	.....	.....
St. Joseph	38			5.00	31.0
Slocum	35[c]	2[c]	19.6[c]	1.40	14.0
South Haven	40	− 6	23.2	4.14	15.0
Thomaston	32	−24	9.2	0.80	8.0
Thornville	37	− 5	21.4	3.53	19.0
Traverse City	38	− 1	19.2	2.30	23.0
Vassar	40	− 6	20.4	1.38	10.1
Wasepi	38	− 4	19.4	3.24	16.5
Waverly		4	.....	2.26	22.0
Webberville	38	− 4	18.6	2.40	20.5
West Branch	37[d]	−10[c]	16.4[d]	1.75	17.0
Wetmore				1.71	17.1
Whitefish Point	35	−10	18.3	2.70	25.4
Ypsilanti	38	− 4	21.0	2.58	12.0
Minnesota.					
Albert Lea	42	−27	12.8	1.40	14.0
Alexandria	34	−22	4.7	0.40	4.0
Angus	31	−31	5.0	2.60	26.0
Ashby	32	−22	10.0	0.50	8.0
Beardsley	39	−19	12.8	0.34	.....
Beaulieu	30	−28	5.2	0.42	4.5
Bemidji	31	−24	8.0	0.71	.....
Bird Island	37	−25	11.2	0.67	5.3
Blooming Prairie	40	−29	11.3	1.10	10.2
Brainerd	31[c]	−35	6.8[c]	1.15	11.5
Caledonia	36	−29	11.6	0.98	10.5
Collegeville	35	−18	12.7	0.46	4.8
Crookston	31	−26	5.4	1.30	13.0
Currie[c]	36[f]	−25[c]	12.8[c]	.....	.....
Deephaven				0.30	4.5
Detroit	31	−35	3.4	0.99	5.0

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Minnesota—Cont'd.	°	°	°	*Ins.*	*Ins.*
Duluth (sub station)	30	−24	6.8	1.28	10.9
Faribault	38	−27	11.6	0.37	6.4
Farmington	35	−25	9.4	0.70	7.0
Fergus Falls	35	−24	10.0	0.75	7.3
Floodwood	42	−30	8.0	0.75	12.0
Glencoe	36	−19	10.3	0.55	5.5
Hallock	32	−32	3.4	1.59	13.5
Lake Winnibigoshish	33	−26	4.8	1.02	10.7
Leech	34	−30	3.8	1.02	9.3
Long Prairie	31	−26	8.2	0.25	3.0
Luverne	42	−30	14.8	1.25	12.5
Lynd	37	−19	15.0	0.36	5.0
Mapleplain	35	−25	10.0	1.16	12.0
Milaca	32	−27	8.2	0.63	5.5
Milan	39	−24	12.9	0.90	9.0
Minneapolis[1]	32[g]	−23	11.0	0.76	7.5
Montevideo	40	−21	11.6	0.63	5.1
Morris	34	−20	10.4	0.53	5.3
Mount Iron	28	−38	3.2	2.73	27.2
New London	34	−24	9.6	0.28	4.0
New Richland	41	−27	13.2	0.80	8.0
New Ulm	40	−20	10.8	1.12	11.2
Park Rapids	30	−28	4.3	0.87	8.7
Pine River	30	−26	3.8	0.67	6.5
Pipestone	40	−25	16.0	0.13	1.3
Pleasant Mounds	44	−30	15.0	0.71	8.2
Pokegama Falls	30	−45	−0.6	1.22	13.3
Redwing *a*				0.53	7.0
Redwing *b*	37	−25	11.4	0.35	5.5
Reeds				0.43	10.5
Rolling Green	47	−23	15.0	0.60	6.0
St. Charles	37	−26	11.4	1.85	18.5
St. Peter	43	−27	13.0	0.87	8.7
Sandy Lake Dam	29	−29	4.8	1.43	15.2
Shakopee	37	−24	11.8	0.99	10.0
Tower	38	−31	2.4	0.67	6.7
Two Harbors	38	−25	10.2	0.35	1.0
Wabasha	39	−23	13.4	0.76	9.8
Winnebago	50	−21	16.0	0.57	7.5
Winona	40	−20	14.4	0.57	8.0
Wyoming				0.51	5.1
Zumbrota	36	−25	17.0	.....	.....
Mississippi.					
Aberdeen	67	13	36.3	2.43	T.
Agricultural College	70	18	42.0	2.35	1.9
Austin	67[c]	16	40.8[c]	6.63	1.0
Batesville	72	17	39.1	5.30	4.5
Bay St. Louis	68	24	48.0	3.23	
Biloxi	67	26	49.2	4.14	
Boggan[d]	77	17	43.8	.....	
Booneville	61	15	39.2	4.60	1.0
Canton	72	17	44.2	2.23	
Columbus	67	19	39.0	2.47	
Corinth	60	15	35.8	4.39	T.
Crystal Springs	74	21	43.8	3.68	
Duck Hill	73	19	42.0	4.56	2.8
Edwards	74	20	44.9	2.98	
Fayette	77	20	44.4	3.17	T.
Fayette (near)				3.46	
Greenville *a*	70	23	44.4	4.21	T.
Greenville *b*	73	23	42.4	4.49	T.
Greenwood	75	18	42.2	4.46	0.8
Hattiesburg	74	19	45.8	5.01	T.
Hazlehurst	79	19	44.6	3.70	T.
Hernando	68	13	39.6	5.65	2.5
Holly Springs	65	16	37.2	5.07	1.0
Indianola	65[e]	21[e]	40.2[e]	.....	
Jackson	75	20	44.6	3.07	
Kosciusko	71	19	40.9	1.85	1.5
Lake	75	16	41.3	2.83	T.
Lake Como	69	20	45.9	4.34	
Leakesville	72	19	45.3	5.22	T.
Louisville	73	20	43.6	2.69	3.0
McNeill	78	24	48.9	4.74	
Macon	72	20	39.0	2.62	1.0
Magnolia	77	18	45.6	4.70	T.
Natchez	80	25	46.7	4.40	
Nittayuma		17	.....	2.77	
Okolona	67	17	40.2	2.40	T.
Patmos				3.01	T.
Pearlington	74	22	47.6	3.54	
Pittsboro	70	18	40.9	4.77	3.0
Pontotoc	68	16	40.6	3.92	1.5
Port Gibson	75	19	45.0	3.22	0.7
Ripley	65	12	37.1	4.65	2.0
Shoccoe	77	13	43.4	2.26	
Stonington				2.84	T.
Suffolk	76	20	45.3	4.95	T.
Swartwout	72	21	47.5	3.57	
Thornton	74	18	43.2	2.80	
Tupelo	68	16	39.0	3.97	
University	69	16	41.6	5.44	2.2
Utica	75	24	48.2	3.26	T.
Walnutgrove	74	18	44.1	2.20	
Watervalley	72	18	39.5	4.70	5.5
Waynesboro	70	19	41.6	5.22	1.5
Woodville	72	25	46.8	4.89	
Yazoo City	76	19	42.4	2.61	

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Missouri.	°	°	°	*Ins.*	*Ins.*
Appleton City	60	6	32.8	0.73	T.
Arthur	65	8	33.4	1.49	2.0
Avalon	56	− 6	28.3	1.00	2.8
Bethany	55	− 9	25.5	0.86	6.0
Birchtree	62[c]	6[b]	34.6[b]	2.26	2.0
Blue Springs	59	− 1	31.0	1.35	0.6
Boonville				0.59	0.4
Brunswick	52	− 1	27.4	1.14	1.8
Carrollton	59	0	29.1	1.34	0.9
Caruthersville[1]	59	12	38.0	3.23	T.
Conception	60	− 8	26.4	0.35	3.5
Darksville	57	− 4	27.4	1.52	3.5
Dean	65[f]	7[f]	36.6[f]	1.76	
Desoto	63	6	32.0	1.17	1.1
Downing				0.48	1.0
Edgehill	59	6	32.4	2.05	1.5
Eightmile[*2]				1.63	3.0
Fairport				0.94	3.0
Fayette	59	− 2	28.4	0.86	3.2
Fulton	61	− 3	29.2	1.24	4.0
Gallatin[*1]	54	− 2	28.8	1.40	2.5
Gano	65	1	32.5	1.68	2.2
Glasgow				0.95	5.0
Gorin				0.45	T.
Grant City	59	− 9	26.0	0.37	2.0
Halfway	62	1	33.7	1.86	2.0
Harrisonville	58	3	29.6	1.62	2.0
Hazlehurst				1.38	2.0
Houston	61	5	33.4	1.73	1.2
Huntsville	57	− 4	27.8	1.33	4.3
Ironton	62	5	33.0	2.67	1.8
Jackson	56	7	34.4	3.10	1.0
Jefferson City	62	− 2	30.0	0.83	2.5
Joplin	64	10	37.4	1.81	2.5
Kidder	58	− 6	26.9	1.39	2.3
Koshkonong	64[f]	7	34.2[c]	3.01	2.2
Lamar	62	8	35.1	1.86	2.5
Lamonte				0.86	T.
Lebanon	60	0	31.8	2.45	3.5
Lexington	60	0	30.6	1.22	2.0
Liberty	58	− 1	30.2	1.52	1.8
Louisiana	58[c]	− 8[b]	26.5[c]	0.95	1.0
Macon	56	− 6	26.9	1.43	2.8
Marblehill	58	7	33.3	2.59	0.4
Marshall	58	− 1	28.2	0.98	2.7
Maryville	57	− 8	24.4	0.30	3.0
Mexico	58	− 5	28.6	1.35	4.0
Miami[*3]	54	− 3	28.4	1.36	4.4
Mineral Springs	61	7	35.8	2.90	0.5
Monroe City	59	− 9	25.2	0.79	3.6
Montreal	62	−11	30.2	1.58	3.3
Mountaingrove	60	5	32.7	1.61	2.5
Mount Vernon	62	7	34.3	1.84	1.5
Neosho	65	9	36.2	2.19	1.0
Nevada				1.45	2.5
New Haven	62	1	31.2	1.97	5.0
New Madrid				4.62	
New Palestine	64	0	31.8	0.31	1.1
Oakfield	64	− 4	30.6	1.15	3.0
Olden	64	6	34.7	2.45	1.5
Oregon	60	− 6	27.7	0.39	2.6
Paimyra[*5]	50	− 4	26.4	1.45	4.5
Pine Hill				2.51	0.5
Princeton	47	− 8	24.7	0.96	4.0
Protem	65	10	37.4	2.87	T.
Richmond				1.70	4.0
Rockport				0.13	2.0
Rolla				1.62	4.0
St. Charles	55	− 2	29.2	1.41	4.2
St. Joseph				1.24	4.0
Sarcoxie				2.28	T.
Sedalia	58	1	31.2	1.06	3.0
Seymour	60	3	32.6	1.42	1.5
Shelbina				0.70	3.0
Sikeston	58	9	35.4	3.57	0.2
Steffenville	55	− 5	26.1	1.31	4.0
Sublett	53	− 7	25.0	1.45	4.0
Trenton	55	− 6	26.7	1.26	3.0
Unionville	48	−10	24.9	1.46	2.5
Warrensburg	58	2	31.6	1.15	2.7
Warrenton	60	− 4	27.0	1.51	6.0
Wheatlan				1.40	4.5
Willowsprings	63	4	33.2	2.63	1.5
Zeitonia	58	7	32.6	2.75	1.4
Montana.					
Adel	56	− 5	30.0	1.00	10.0
Anaconda	50	3	27.8	.....	.....
Augusta	61	−14	33.0	0.69	6.0
Billings[g]	64	2	31.4	.....	.....
Boulder	54	1	25.8	0.34	.....
Butte	55	9	28.6	0.85	8.5
Canyon Ferry	46	1	25.2	0.46	5.1
Chinook	65	−12	29.0	0.05	0.5
Columbia Falls	45	7	25.4	1.60	7.0
Crow Agency	63	− 7	29.2	1.30	13.0
Culbertson	50	−17	19.0	0.43	.....
Cutbank	60	−27	29.6	0.07	.....
Dayton	42	5	25.6	0.83	8.3

TABLE II.—*Climatological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Montana—Cont'd.	°	°	°	*Ins.*	*Ins.*
Deerlodge	52	−2	22.9	0.11	1.1
Dillon	53	4	27.4	1.01	10.1
Ekalaka	50	−18	23.9	.....	.....
Fort Benton	54	−12	31.9	0.30	3.0
Glasgow	53	−20	24.0	0.07	.....
Glendive	55	−20	23.4	0.75	7.5
Greatfalls	56	−12	33.8	0.91	9.1
Hamilton	57	9	27.4	0.22	6.0
Lamedeer	64	−13	26.8	2.00	20.0
Lewistown	63	−13	29.2	0.70	7.0
Livingston	60	4	32.4	0.58	8.0
Marysville [b]	56	−3	26.4	.....	.....
Missoula	47	3	24.2	0.87	6.0
Ovando	41	−1	21.8	1.05	10.5
Philipsburg	56	4	28.3	0.69	5.2
Plains	47	16	28.6	0.30	3.0
Poplar	53	−17	22.8	0.35	3.5
Redlodge	51	−4	27.4	0.81	16.5
Ridgelawn	50	−18	20.8	1.65	9.0
St. Pauls	61[b]	−10	28.4[b]	0.17	5.5
St. Peter	55	−6	30.7	0.62	14.5
Springbrook	60	−25	24.3	1.16	11.6
Toston	55	3	27.8	0.25	2.5
Troy	46	9	28.8	1.37	6.0
Twin Bridges	51	−5	24.4	0.30	3.0
Two Dot	57	3	32.0	.....	19.0
Utica	61	−15	29.9	0.65	12.0
Wibaux	50	−24	30.4	1.18	11.8
Wolf Creek	59	−2	31.9	0.41	7.4
Wolsey	51	−11	21.2	1.41	32.0
Yale	58	−5	29.4	1.30	13.0
Nebraska.					
Agate	60	−12	27.0	0.12	2.0
Agee *1	54	−12	22.6	0.40	4.0
Albion	.....	−3	.....	0.00	
Alliance	62	−10	28.6	0.25	2.5
Alma	66	5	31.8	0.00	
Ansley	62	−3	29.3	T.	0.3
Arapahoe	.....	.....	.....	0.00	
Arcadia	.....	.....	.....	0.00	
Ashland *a*	54	−5	26.6	T.	T.
Ashland *b*	.....	.....	.....	T.	T.
Ashton	..	..	..	T.	T.
Auburn	58	−3	28.1	0.20	0.7
Aurora	60	0	31.2	0.00	
Bartley	63	1	30.8	0.14	0.1
Beatrice	54	0	28.8	0.05	0.5
Beaver	63	5	32.8	0.01	0.1
Bellevue	.....	.....	.....	0.39	3.2
Benkleman	.....	.....	.....	0.10	1.0
Blair	52	−10	24.4	0.12	1.2
Bluehill	.....	.....	.....	0.05	0.5
Bradshaw	.....	.....	.....	0.22	2.2
Bridgeport	61	−1	30.1	T.	T.
Brokenbow	60	−2	29.0	T.	T.
Burchard	.....	.....	.....	0.10	1.0
Burwell	.....	.....	.....	0.20	2.0
Callaway	58	−2	29.1	T	T.
Central City	.....	.....	.....	0.30	3.0
Chester	.....	.....	.....	0.10	1.0
Columbus	57	−2	27.8	0.06	0.5
Crete	56	−1	29.0	0.08	0.8
Culbertson	65	2	29.4	0.09	2.0
Curtis	60[b]	1[b]	27.8[b]	0.10	1.0
David City	54	−4	26.8	0.02	0.2
Dawson	60	−3	28.4	0.05	.....
Edgar	.....	.....	.....	T.	T.
Ericson	.....	.....	.....	0.10	1.0
Ewing	.....	.....	.....	T.	T.
Fairbury	58[b]	0[b]	28.3[b]	T.	T.
Fairmont	59	0	28.0	T.	T.
Fort Robinson	62	−5	30.7	0.38	3.8
Franklin	61	1	30.1	0.00	
Fremont	53	−7	25.4	0.17	0.4
Fullerton	.....	.....	.....	T.	T.
Geneva	57	−1	29.2	0.10	1.0
Genoa (near)	55	−3	27.1	T.	T.
Gering	65	−4	32.2	0.05	0.5
Gordon	.....	.....	.....	0.30	3.0
Gothenburg	63	3[c]	29.8[c]	0.00	
Grand Island *b*	61	1	29.4	0.01	0.1
Greeley	.....	.....	.....	T.	T.
Guide Rock	.....	.....	.....	T.	T.
Haigler	.....	.....	.....	0.10	.....
Halsey	62	−4	30.2	0.05	.....
Harvard	58	0	28.4	T.	T.
Hastings *1	59	4	28.7	T.	T.
Hayes Center	.....	.....	.....	0.10	1.0
Hay Spring	59	−5	27.2	T.	T.
Hebron	56	3	30.2	T.	T.
Hickman	.....	.....	.....	0.20	2.0
Holbrook	.....	.....	.....	T.	T.
Holdredge	62	3	32.0	T	0.1
Hooper *1	51	−4	24.3	0.10	1.1
Imperial	63	3	33.3	T.	T.
Johnstown	.....	.....	.....	0.32	0.7
Kearney	60	4	30.2	0.02	T.
Kennedy	59	−4	28.2	0.40	4.0
Nebraska—Cont'd.	°	°	°	*Ins.*	*Ins.*
Kimball	58	6	31.8	T.	T.
Kirkwood	56	−11	26.7	0.12	1.2
Leavitt	54	−8	26.6	0.03	T.
Lexington	60	3	29.2	0.00	
Lockridge	59	−2	28.2	0.02	T.
Lodgepole	62	−2	30.2	0.08	0.8
Loup	60	−2	27.2	0.00	
Lynch	56	−12	25.0	0.30	3.0
McCook	..	..	..	T.	T.
McCool Junction	.....	.....	.....	0.00	
Madison	55	−5	25.8	0.20	1.5
Madrid [m]	57	−2	27.8	0.30	3.0
Marquette	.....	.....	.....	T.	T.
Mason	.....	.....	.....	0.10	1.0
Minden	60	3	30.0	0.01	0.2
Monroe	.....	.....	.....	T.	T.
Nebraska City *c*	52	−8[l]	27.0[l]	0.15	1.5
Nemaha	.....	.....	.....	T.	T.
Norfolk	57	−12	23.1	0.16	2.4
North Loup	62	−2	28.6	T.	T.
Oakdale	56	−8	24.1	0.13	1.3
Odell	.....	.....	.....	0.10	1.0
O'Neill	60	−10	28.3	.....	.....
Ord	.....	.....	.....	0.00	
Palmer	.....	.....	.....	0.20	2.0
Palmyra *1	58	0	26.4	0.10	.....
Pawnee City	57	−2	28.0	0.22	T.
Plattsmouth *b*	.....	0	.....	0.34	3.4
Purdum	60	−5	28.6	0.05	0.5
Ravenna *a*	61	2	28.8	0.03	0.3
Redcloud	62	4	30.8	T.	T.
Republican	.....	.....	.....	T.	T.
Rulo	.....	.....	.....	0.20	2.0
St. Libory	.....	.....	.....	T.	T
St. Paul	62	0	29.6	0.06	0.5
Salem	.....	.....	.....	0.20	2.0
Santee	52	−12	24.0	0.19	3.3
Schuyler	.....	.....	.....	0.25	2.5
Seward	.....	−2	.....	0.14	1.4
Smithfield	.....	.....	.....	0.00	
Spragg	.....	.....	.....	0.16	1.6
Springview	55	−9	26.2	0.05	0.5
Stanton	49	−11	23.4	0.17	1.7
Strang	.....	.....	.....	T.	T.
Stratton	.....	.....	.....	0.01	
Stromsburg	.....	.....	.....	0.00	
Superior	55	0	29.6	T.	T
Syracuse	.....	.....	.....	0.20	2.0
Tablerock	.....	.....	.....	0.12	T.
Tecumseh *c*	.....	.....	.....	0.06	T.
Tekamah	56	−10	25.8	0.27	2.6
Turlington	55	−4	27.4	0.15	1.5
University Farm	55	−2	27.6	0.10	0.5
Wahoo	.....	.....	.....	0.11	T.
Wakefield	53	−13	22.4	0.21	2.1
Wallace	.....	.....	.....	0.00	
Wauneta	.....	.....	.....	0.00	
Weeping Water	50	0	24.5	0.23	2.8
Westpoint	53	−10	24.4	0.18	1.1
Wilber	.....	.....	.....	0.00	
Wilsonville	.....	.....	.....	T.	
Winnebago	54	−12	22.8	0.25	3.0
Wisner	.....	.....	.....	0.33	3.3
Wymore	.....	.....	.....	T.	T.
York	60	1	30.1	0.00	
Nevada.					
Austin	56	11	31.0	0.13	
Battle Mountain	70	0	32.6	1.10	11.0
Belmont	53	11	30.2	T.	T.
Beoware *1	58	8	28.9	0.20	2.0
Candelaria	57	16	35.7	T.	T.
Carson City	68	6	32.1	0.11	0.3
Cranes Ranch	.....	.....	.....	0.25	2.5
Dyer	58	−9	27.8	0.00	
Elko	61	−5	29.6	0.35	3.5
Eureka	58	3	29.7	0.20	2.0
Fallon	55	3	28.4	.....	.....
Glenbrook	.....	.....	.....	0.48	7.0
Golconda *1	50	14	31.0	T.	T.
Halleck	56	3	26.3	0.00	
Hawthorne	60	12	32.3	T.	T.
Humboldt	53	9	30.0	0.15	1.0
Lee	.....	.....	.....	0.68	2.0
Lewers Ranch	65	15	35.8	0.31	1.0
Lovelocks *1	56	8	27.3	0.00	
Mill City *1	40	10	25.7	0.00	
Morey	60	12	34.2	T.	T.
Palisade	67	5	33.0	0.00	
Palmetto	62	1	31.2	0.00	
Potts	62	−7	28.5	0.08	1.0
Reno State University	66	9	33.1	0.15	.....
Sodaville	58	0	32.6	0.00	
Tecoma	43	4	24.8	0.05	0.5
Toano * [b]	50	0	24.0	0.10	1.0
Wabuska *1	60	8	30.2	0.00	
Wadsworth *1	60	4	30.2	T.	
Wells	40	0	20.5	0.80	8.0
Wood	53	5	28.0	0.46	.....
New Hampshire.	°	°	°	*Ins.*	*Ins.*
Alstead	47	−10	19.8	3.85	17.5
Bartlett	.....	.....	.....	5.09	19.3
Berlin Mills	47	−22	16.6	2.20	12.8
Bethlehem	47	−14	16.4	1.78	11.5
Bretton Wood	.....	.....	.....	3.84	.....
Brookline *1	52	−20	22.9	3.08	13.8
Chatham	45	−17	17.0	4.75	25.0
Concord	49	−15	20.7	2.71	14.6
Durham	52	−8	23.3	2.25	12.0
Franklin Falls	49	−9	21.4	2.42	13.2
Grafton	46	−13	18.3	2.83	13.5
Hanover	46	−15	17.7	2.94	16.0
Jefferson	.....	.....	.....	2.02	13.0
Keene	51	−14	20.6	2.72	16.5
Littleton	48	−16	15.7	2.21	19.0
Nashua	54	−11	23.6	3.00	11.2
Newton	52	−15	22.7	2.70	9.0
North Stratford	.....	.....	.....	1.44	16.8
North Woodstock	.....	.....	.....	3.43	.....
Plymouth	45	−8	18.8	2.53	12.1
Stratford	45	−20	15.2	1.79	8.0
West Stewartstown	.....	.....	.....	2.21	15.5
New Jersey.					
Asbury Park	54	8	31.4	4.27	4.8
Barnegat	54	4	31.2	4.96	2.0
Bayonne	53	6	29.2	3.44	7.8
Belvidere	51	0	25.5	4.35	22.2
Bergen Point	53	5	29.2	3.77	7.6
Beverly	55	10	30.7	3.84	9.3
Blairstown	50	−6	23.9	4.30	17.0
Bridgeton	52	10	31.2	4.12	7.5
Canton	.....	.....	.....	3.56	5.0
Cape May C. H.	53	11	32.4	3.40	4.8
Charlotteburg	48	−8	24.2	5.15	11.0
Chester	50	0	24.5	4.35	21.0
Clayton	52	10	30.0	3.72	6.0
College Farm	54	6	28.7	3.53	4.5
Dover	48	−1	23.4	5.25	17.5
Englewood	50	4	27.2	3.26	8.0
Flemington	53	7	27.8	3.99	8.5
Friesburg	52	8	30.2	3.80	6.5
Hightstown	54	6	29.1	3.53	4.0
Imlaystown	54	9	30.6	3.67	5.1
Indian Mills	53	7	30.2	4.07	6.0
Lakewood	55	5	30.8	3.74	4.0
Lambertville	54	7	28.8	3.90	10.5
Layton	48	−13	21.4	5.22	26.0
Moorestown	54	9	30.0	4.48	7.4
Newark	52	5	28.2	3.56	8.5
New Brunswick	54	7	29.0	4.24	7.8
Newton	50	−3	22.8	4.39	22.0
Oceanic	54	7	31.2	4.26	6.2
Paterson	51	7	29.8	4.21	9.0
Pemberton	55	9	29.8	3.32	3.8
Phillipsburg	52	3	26.6	3.35	14.0
Plainfield	54	6	27.2	4.14	7.1
Pleasantville	.....	.....	.....	4.55	1.3
Rancocas	.....	.....	.....	4.17	8.0
Rivervale	54	−7	26.5	4.73	12.0
Salem	.....	.....	.....	3.94	6.4
Sandy Hook	52	9	31.1	3.92	4.9
Somerville	54	6	27.5	4.06	6.5
South Orange	51	4	28.0	4.35	10.5
Sussex	50	−6	23.6	4.40	13.5
Toms River	54	5	29.8	4.23	3.0
Trenton	56	10	33.4	3.20	3.0
Tuckerton	53	7	31.0	4.52	4.0
Vineland	54	9	30.4	4.28	7.8
Woodbine	52	7	30.0	3.78	7.5
Woodstown	.....	.....	.....	4.10	7.0
New Mexico.					
Albert	77[e]	15[e]	41.5[e]	T.	T.
Albuquerque	65	9	33.7	0.00	
Arabela	75	14	40.6	0.00	
Bellranch	.....	.....	.....	0.00	
Cambray	.....	.....	.....	0.00	
Carlsbad	84	10	46.4	0.00	
Cloudcroft	52	7	27.6	0.28	2.8
Deming	.....	.....	.....	0.05	
Dorsey	65	10	33.8	0.10	2.5
Eagle Rock Ranch	63	2	29.3	0.25	3.6
Fort Bayard	71	15	39.2	T.	T.
Fort Stanton	62	3	33.4	0.05	T.
Fort Union	66	0	34.4	0.05	0.5
Fort Wingate	60	6	32.4	0.06	0.6
Fruitland	79	−5	31.0	T.	T.
Gage	.....	.....	.....	T.	
Gallinas Spring	62	8	33.6	0.05	0.5
Golden	.....	.....	.....	0.01	0.1
Las Vegas	67	−1	32.4	0.12	2.0
Lordsburg	.....	.....	.....	0.21	
Luna	62	1	29.4	0.10	1.0
Mesilla Park	72	14	40.9	0.01	
Mountainair	61	−11	31.4	0.52	5.2
Raton	64	2	32.0	0.25	2.5
Roswell	76	6	38.8	0.00	
San Marcial [f]	71	9	36.0	0.00	
Strauss	.....	.....	.....	T.	T.

TABLE II.—*Climatological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
New Mexico—Cont'd.	°	°	°	*Ins.*	*Ins.*
Taos	67	0	29.4[j]	0.10	1.2
Winsors	61	9	27.1	0.21	2.1
New York.					
Adams				8.42	88.0
Addison	41	−7	23.2	0.79	7.9
Akron				1.68	
Alden	44	3	23.6	2.58	22.4
Amsterdam	45	−13	19.9	2.10	17.9
Angelica	40	−5	20.5	0.77	7.7
Appleton	52	2	25.6	1.33	4.0
Arcade	40	−9	19.4	2.70	43.3
Athens	49	−6	23.1	3.46	20.7
Atlanta	40	−7	21.2	1.67	13.0
Auburn	42	−2	23.1	1.85	15.0
Avon	41	−3	22.5	1.36	11.8
Baldwinsville	43	−11	23.4	2.51	22.0
Beaver				5.90	59.0
Bedford	53	−1	26.3	3.86	1.4
Berlin				2.65	18.0
Blue Mount Lake				6.70	37.0
Bolivar	40	−10	20.6	1.52	11.8
Bouckville	41	−9	18.9	4.72	41.0
Boyds Corners				4.67	
Brockport	40	1	22.8	2.39	21.9
Caldwell	45	−12	19.8	3.71	14.1
Canajoharie	46	−16	19.6	2.62	24.0
Canaan Four Corners	47	−11	19.2	2.60	12.0
Carmel	47	−10	22.0	4.91	19.5
Carvers Falls	44	−14	18.4	2.41	9.0
Chazy	40	−19	16.4	1.50	14.5
Cooperstown	43	−15	20.0	2.66	15.2
Cortland	41	−13	20.6	1.62	10.8
Cutchogue	52	5	30.2	4.25	5.0
Deansboro				3.12	26.0
Dekalb Junction	42	−15	17.4	2.14	23.1
De Ruyter	41	−17	19.4	2.31	19.5
Easton				2.08	13.0
Elba	44	0	22.6	4.05	18.5
Elmira	44	−5	24.2	0.81	7.0
Fayetteville	50	−10	22.7	2.00	20.7
Franklinville	39	−10	19.0	2.36	23.6
Gansevoort				2.76	19.5
Glens Falls	42	−13	19.8	2.55	17.7
Gloversville	42	−15	18.7	3.28	28.0
Greenwich	50[e]	−11[e]	22.0[e]	1.88	13.0
Griffin Corners	46	−14	19.5	3.82	21.5
Harkness	45	−9	17.8	1.91	16.4
Haskinville				1.21	10.9
Hemlock	41	−1	24.2	0.78	7.2
Homer	42	−14	19.8	1.76	14.2
Honeymead Brook	49	−13	21.2	4.06	14.0
Indian Lake	39	−26	13.9	4.15	36.5
Ithaca	43	−5	23.2	1.15	13.3
Jamestown	45	−4	21.6	2.46	16.0
Jeffersonville	45	−13	21.0	2.81	23.0
Keene Valley	45	−18	17.4	3.07	15.7
King Ferry				1.21	12.1
Liberty	43	−8	19.9	1.90	17.4
Littlefalls, City Res.	41	−9	18.4	2.23	26.5
Lockport	45	1	24.6	1.66	4.7
Lowville	42	−22	15.8	5.14	38.5
Lyndonville				1.03	8.5
Lyons	41	−1	23.6	2.68	19.5
Middletown	46	0	23.2	4.39	24.0
Mohonk Lake	46	−3	22.6	2.35	22.5
Moira	42	−16	16.5	3.69	22.5
Newark Valley				1.52	13.5
New Lisbon	44	−22	18.2	3.35	25.0
North Hammond	40	−16	17.6	0.84	0.5
Number Four	40	−20	14.5	9.56	99.7
Ogdensburg	42	−16	15.8	1.13	12.1
Oneonta	42	−13	21.7	2.36	20.0
Oswegatchie	43	−14	16.0	2.09	25.0
Otto	45	−1	21.0	1.43	4.2
Oxford	42	−20	21.0	5.53	47.9
Oyster Bay	56	8	29.6	5.98	10.5
Palermo				2.84	25.1
Penn Yan	42	0	24.4	0.75	6.6
Perry City	41	−12	21.2	1.52	13.5
Plattsburg Barracks				2.90	26.0
Port Jervis	49	−6	23.0	3.86	26.0
Potsdam	42	−18	15.6	2.65	17.9
Primrose	52	−1	26.8	3.77	12.0
Redhook				3.43	3.5
Richmondville	46	−8	20.4	2.42	14.5
Ridgeway	47	3	24.4	2.16	11.8
Rome	43	−10	21.2	2.98	38.0
Romulus	42	2	24.6	1.53	12.7
Salisbury Mills				4.20	21.0
Saranac Lake	41	−20	14.4	2.83	30.5
Saratoga Springs	44	−14	20.3	2.17	14.1
Setauket	53	8	30.4	4.26	6.2
Shortsville	42	1	23.1	1.20	7.3
Skaneateles				2.01	16.6
Southampton	53	5	30.2	3.70	2.5
South Butler	41	0	22.8	1.64	16.8
South Canisteo	40	−3	21.0	1.38	12.8
Southeast Reservoir				3.68	
South Kortright	48	−21	19.3	3.25	17.8
South Schroon	44	−17	16.8	2.92	24.4
Speer Falls	45	−13	19.9	2.53	13.5
Straits Corners	40[d]	−12[d]	19.8[d]	1.90	15.0
Ticonderoga	46	−6	21.2	3.00	19.0
Volusia	46	1	21.8	3.93	39.2
Walton	48	−14	20.2	2.68	21.2
Wappinger Falls	51	−16	21.2	3.98	17.0
Warwick				3.68	21.0
Watertown	42	−11	19.4	2.54	20.5
Waverly	42	−11	22.8	1.49	13.6
Wedgwood	39	−6	20.4	1.93	20.0
Wells	42	−22	16.3	4.12	30.6
West Berne	46	−18	18.8	2.65	20.5
Westfield *b*	48	3	23.6	2.82	
Windham	50	−13	21.0	3.02	22.0
Youngstown				1.62	6.4
North Carolina.					
Brevard	58	7[h]	32.6[f]	0.90	0.2
Brewers	60	9	34.6	1.55	2.0
Bryson City				1.14	2.0
Chapelhill	59[i]	14[i]	37.7[i]	2.58	
Currituck				2.78	
Edenton	61[e]	18[e]	39.0[e]	3.13	
Fayetteville	65	15	39.4	2.28	T.
Goldsboro	63[e]	17[d]	37.6[e]	1.61	T.
Graham				1.67	T.
Greensboro	55	14	35.3	1.96	T.
Henderson	58	13	36.0	1.85	
Hendersonville	60	9	33.6	1.55	1.3
Henrietta	59	15	35.7	1.41	
Highlands	50	5	28.2	3.08	6.0
Horse Cove	57	11	34.8	2.80	4.1
Hot Springs	59	10	34.4		
Jefferson	53	3	30.6	1.32	3.3
Kinston	63	15	36.2	1.99	T.
Kittyhawk	63	23	41.0	2.84	
Lenoir	60	10	36.9	1.87	T.
Linville	58	−7	26.7	2.50	9.0
Littleton	58	12	36.0	2.68	0.5
Louisburg	59	14	36.6	3.10	
Lumberton	63	18	37.1	2.52	T.
Marion	58	10	35.8	1.22	0.9
Marshall	60[b]	10[b]	33.6[b]	0.60	2.3
Mocksville				2.21	1.0
Moncure	61	13	36.6	2.85	T.
Monroe	63	10	36.7	1.56	T.
Morganton	57	11	35.4	0.99	
Mountairy	52[b]	10[b]	33.4[b]	1.77	0.7
Murphy				2.22	2.5
Newbern	66	22	42.6	2.38	T.
Patterson *b*[1]	51	13	30.6	1.68	0.5
Pittsboro	60[e]	12[e]	36.8[e]	2.11	T.
Reidsville	55	11	35.8	2.03	1.5
Rockingham	64	16	38.3	3.01	1.0
Salem	53	13	34.4		
Salisbury	58	12	38.2	1.78	0.1
Saxon	53	9	33.2	2.17	1.7
Selma	63	15	37.8	2.70	T.
Settle *b*[5]	56	15	36.0	1.50	0.5
Sloan	68	15	39.2	1.89	T.
Soapstone Mount	59	11	36.0	2.15	T.
Southern Pines *a*	61	14	39.9	3.08	T.
Southern Pines *b*	61	14	38.1	2.96	1.0
Southport	67	17	43.1	2.97	
Springhope	60	17	37.5	1.78	T.
Statesville	57	10	35.4	1.69	0.2
Tarboro	64	15	38.0	2.42	0.5
Washington	66	17	40.8	2.83	T.
Waynesville	56	8	31.2	2.25	T.
Weldon *a*	60	15	35.5	1.71	T.
Weldon *b*				1.76	T.
Whiteville	68	15	40.4	1.89	2.0
North Dakota.					
Amenia	38	−26	9.2	0.53	5.3
Ashley	40	−24	9.0	0.47	3.5
Berlin	42	−33	9.2	0.70	6.0
Buxton	35	−25	8.4	0.56	5.6
Churchs Ferry	43[f]	−25[f]	7.6[f]	0.60	6.0
Coalharbor				1.00	10.0
Cooperstown		−27			
Devils Lake	36	−25	7.8	0.63	6.3
Dickinson	42	−21	19.7	0.82	10.4
Donnybrook				1.10	11.0
Dunseith	39	−33	9.0	0.70	7.0
Edgeley	42	−30	12.8	0.28	3.3
Elbowoods	46	−25	16.6	0.79	6.9
Ellendale	43	−22	13.8	0.30	3.0
Fargo	37	−25	7.8	0.10	1.0
Forman	37	−27	11.6	0.10	0.8
Fort Yates	48	−19	18.4	0.26	2.0
Fullerton	42	−26	11.8	0.73	7.3
Glenullin	43	−19	18.1	1.04	8.2
Grafton	34[e]	−23	4.6[e]	1.45	14.5
Hamilton	39	−26	4.0	1.67	14.6
Hannaford[1]	36	−26	6.0	0.12	1.2
Jamestown	57	−26	15.2	0.86	8.6
Larimore	40	−23	7.4	0.75	7.5
North Dakota—Cont'd.	°	°	°	*Ins.*	*Ins.*
Lisbon	40	−27	9.0	0.10	1.0
McKinney	42	−28	11.8	0.32	3.2
Manfred	43	−30	10.3	1.27	13.4
Mayville [4]	40	−24	10.2	0.51	5.1
Medora	53	−21	22.4	1.05	10.5
Melville	43	−22	10.9	0.65	6.5
Minnewaukon	44	−25	11.0	1.50	15.0
Minot				0.50	5.0
Minto	35	−23	4.6	0.89	8.9
Napoleon	45	−26	9.2	0.54	6.0
New England	42	−25	17.4	0.70	7.0
Oakdale	56	−20	21.0	1.55	15.5
Park River	39	−25	5.2	0.52	4.0
Pembina	33	−31	2.2	0.88	8.8
Portal	42	−25	14.2	1.60	16.0
Power	35	−23	9.2	0.10	1.0
Steele	40	−29	11.2	0.30	3.0
University	38	−25	9.2	1.05	10.5
Wahpeton	38	−16	11.4	0.40	4.0
Willow City	42	−33	7.7	1.30	13.0
Ohio.					
Akron	48	2	23.0	3.17	14.4
Atwater				1.99	6.5
Bangorville	45	−4	21.9	2.76	8.5
Bellefontaine	41	−4	21.5		
Benton Ridge	44	−5	24.0	2.12	9.8
Bladensburg	48	−11	21.8	2.30	8.2
Bowling Green	52	−2	21.2	2.30	7.5
Bucyrus	44	−7	21.8	1.45	11.5
Cadiz	47	−1	23.4	2.85	16.9
Cambridge	55	−10	24.5	2.15	8.0
Camp Dennison	49	−2	25.8	1.81	2.0
Canal Dover	46	−9	22.7	2.74	9.5
Canton	47	2	23.6	1.77	10.3
Cardington	45	−9	21.5	1.85	8.0
Circleville	51	0	24.9	1.46	2.5
Clarington	52	1	26.6	3.00	9.5
Clarksville	48	1	25.3	2.00	2.2
Cleveland *a*	45	4	24.7	1.88	11.4
Cleveland *b*	46	4	22.9	1.36	8.4
Clifton	46	−3	24.0	1.63	2.5
Coalton	57	−3	25.2	1.69	4.0
Dayton *a*				1.43	2.0
Dayton *b*	48	0	25.8	2.00	3.6
Defiance	45	−1	21.8	2.40	8.1
Delaware	47	−10	22.4	2.21	8.7
Demos	47	−1	24.4	2.06	6.5
Elyria	45	−1	23.0	1.72	
Findlay	45	0	23.0	1.73	8.0
Frankfort	53	−4	24.7	1.49	3.0
Fremont	42	−1	23.4	2.56	10.2
Garrettsville	47	−2	21.4	1.74	9.2
Granville	48	−4	23.4	3.04	8.1
Gratiot	45	−6	23.2	2.60	6.8
Green	52	4	26.6	1.89	4.0
Greenfield	50	4	26.0	1.69	3.2
Greenhill	47	−7	21.7	1.63	8.4
Greenville	48	−4	22.8	1.44	4.0
Hanging Rock	53	0	28.6	1.54	4.0
Hedges	43	−5	22.6	2.33	5.5
Hillhouse	45	−1	21.8	2.11	13.5
Hiram	46	−2	22.3	1.46	8.5
Hudson	43	−1	21.4	1.63	
Jacksonboro	49	−1	25.4	2.28	6.0
Kenton	44	−4	21.6	1.55	7.3
Killbuck	48	−3	22.3	2.52	9.0
Lancaster	50	−1	25.2	2.05	7.0
Lima	47	−7	21.1	3.42	13.0
McConnelsville	53	−4	24.4	2.08	7.2
Manara	45	0	23.2	1.41	1.0
Mansfield				2.48	12.3
Marietta	50	1	28.1	1.89	6.8
Marion	44	−6	22.6	2.31	3.5
Medina	47	−3	22.3	1.55	8.0
Milfordton	46	−6	21.8	3.46	10.5
Milligan	52	−11	23.8	2.41	9.0
Millport	46	−10	22.0	1.67	9.1
Montpelier	40	−2	21.2	2.98	9.0
Napoleon	44	1	23.2	1.74	6.5
New Alexandria	50	1	24.0	3.07	1.0
New Berlin	45	−5	21.4	2.04	5.5
New Bremen	44	−6	22.5	2.03	8.0
New Richmond	50	3	27.2	1.58	1.0
New Waterford	46	0	23.6	2.41	9.0
North Lewisburg	44	−3	22.2	1.80	6.5
North Royalton	44	0	20.6	2.49	15.0
Oberlin	46	0	22.8	1.67	3.8
Ohio State University	49	−1	22.8	1.92	2.2
Orangeville	45	−9	22.6	2.92	6.0
Ottawa	43	−5	22.4	1.82	
Pataskala	49	−4	23.0	2.67	8.2
Philo	51	−1	25.2	1.61	6.9
Plattsburg	43[b]	−4	22.4[e]	2.73	8.0
Pomeroy	44	4	26.0	2.67	6.8
Portsmouth *a*				1.66	2.0
Portsmouth *b*	52	5	28.7	1.57	2.3
Pulse	45	−2	24.4	1.93	8.0
Richwood	45	−4	22.0	1.85	6.8

TABLE II.—*Climatological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Ohio—Cont'd.	°	°	°	*Ins.*	*Ins.*
Rittman	45	— 4	20.0	1.30	7.0
Rockyridge	44	— 3	22.6	2.11	3.2
Shenandoah	46	0	21.2	1.63	7.4
Sidney	45	— 5	23.8	2.01	7.0
Somerset	46	— 1	24.6	1.17	.....
Springfield	.....	.....	.....	2.19	4.6
Thurman	51	0	26.1	1.95	5.0
Tiffin	43	1	22.8	2.27	10.5
Upper Sandusky	43	— 3	22.4	2.52	8.9
Urbana	44	— 7	20.2	2.11	4.2
Vickery	42	— 2	22.2	1.90	6.3
Warren	45[1]	5	23.7[f]	2.43	17.3
Warsaw	50	—11	21.8	2.38	10.0
Wauseon	41	— 1	20.8	2.27	12.1
Waverly	52	1	26.2	1.95	4.6
Waynesville	47	0	24.8	2.24	3.0
Wellington	46	0	23.3	1.63	11.0
Willoughby	.....	.....	.....	1.40	6.0
Wilson	52	—5	25.4	2.00	4.0
Wooster	49	—2	21.6	1.95	8.0
Zanesville	.....	.....	.....	1.91	8.1
Oklahoma.					
Arapaho	66	8	39.0	T.	
Beaver	67	9	36.8	0.00	
Binger	66	10	39.3	0.10	
Blackburn[f]	67	8	40.2	0.94	
Chandler	67	12	39.2	0.43	
Cloud Chief	67	9	39.2	0.00	
Eldorado	68	8	41.2	0.00	
Enid	66	12	38.5	T.	
Fort Reno	67	9	40.0	0.00	
Fort Sill	66	11	41.3	0.00	
Guthrie	63	14	39.4	0.52	
Harrington	66	12	41.9	0.01	T.
Hennessey	68	8	40.2	0.08	
Hobart	68	10	41.6	T.	
Jefferson	66	11	38.2	0.25	
Jenkins	67	10	39.4	T.	
Kenton	73	9	36.4	0.10	1.0
Kingfisher	67	10	39.8	T.	T.
McComb	67	11	41.4	0.88	
Mangum	70	15	46.2	T.	
Mecker	68	8	39.6	0.80	
Newkirk	65	10	35.0	T.	
Norman[e]	67	10	40.6	0.49	
Okeene	72	7	43.0	T.	
Pawhuska	68	.....	.....	0.70	
Perry	65	10	40.6	0.04	
Sac and Fox Agency	66	11	40.4	0.21	
Shawnee	65	14	40.0	0.72	
Stillwater	65	10	38.3	0.48	
Taloga	65	9	37.5	0.00	
Temple	67	10	41.4	0.30	
Waukomis	69	12	42.1	0.00	
Weatherford	64	11	38.3	T.	
Oregon.					
Albany	.....	.....	.....	1.91	
Alpha	58	24	40.9	6.08	
Arlington	52	24[d]	34.4[b]	0.42	
Ashland	63	21	38.6	1.24	
Astoria	56	32	43.0	8.85	
Aurora (near)	54	24	39.3	2.72	
Bay City	65	29	45.6	9.92	
Beulah	50	1	27.4	1.07	10.0
Blackbutte	52	26	38.6	2.60	
Blalock	53	23	35.4	0.62	T.
Bullrun	.....	.....	.....	6.97	
Burns	55	9	27.4	0.74	
Burns (near)	.....	.....	.....	0.83	4.0
Butter Creek	.....	.....	.....	0.76	1.1
Cascade Locks	54	28	37.3	8.36	
Coquille	.....	.....	.....	4.94	
Corvallis	56	25	40.0	3.08	
Dayville	63	18	35.7	0.87	0.5
Deschutes	61	11	34.2	0.61	
Detroit	60	18	32.4	3.32	
Doraville	58	26	38.4	3.61	
Drain	58	28	41.5	2.97	
Ella	.....	.....	.....	0.49	
Eugene	62	24	40.0	2.75	
Fairview	65	24	46.2	4.01	
Falls City	53	25	38.0	6.50	
Forestgrove	57	24	43.0	3.72	
Gardiner	69	30	48.4	6.99	
Glenora	53	25	39.2	12.37	
Gold Beach	70	35	51.3	6.49	
Government Camp	59	20	35.5	6.30	24.0
Grants Pass	57	22	38.8	2.18	
Hood River (near)	54	18	34.6	2.73	T.
Huntington	59	9	32.0	0.90	9.0
Jacksonville	55	19	36.8	1.53	T.
Joseph	53	4	24.9	1.70	15.5
Kerby	56	21	37.8	6.43	
Klamath Falls	59	16	33.8	1.36	1.0
Lagrande	58	16	33.7	1.32	1.2
Lakeview	52	12	31.5	0.99	7.3
Langlois	67	30	48.0	5.48	
Lonerock	60	13	34.1	1.00	3.0
Oregon—Cont'd.					
McKenzie Bridge	55	22	38.0	6.34	
McMinnville	56	26	40.6	3.47	
Monroe	57	25	40.4	3.30	
Mount Angel	57	26	40.0	2.05	
Nehalem	.....	.....	.....	10.28	
Newport	61	33	47.6	6.09	
Pine	48	— 3	26.6	2.07	12.0
Prineville	55	17	33.4	0.09	0.4
Riverside	53	20	33.3	0.15	T.
Salem	55	27	41.4	1.95	
Sparta	47	12	28.9	2.69	26.0
Stafford	55	25	39.0	3.61	
The Dalles	56	23	36.2	0.56	
Toledo	64	30	45.7	8.07	
Umatilla	55	20	34.4	0.72	0.2
Wallowa	48	5	27.1	1.63	7.5
Wamic	55	19	31.8	0.45	
Warm Spring	57	17	33.2	0.23	T.
Weston	62	16	33.4	3.51	5.0
Williams	63	20	38.6	2.20	
Pennsylvania.					
Aleppo	50	7	24.2	2.18	11.0
Altoona	49	1	24.6	1.50	.....
Athens	44	— 8	24.0	1.42	9.0
Beaver Dam	.....	.....	.....	1.77	.....
Bellefonte	57	0	26.8	2.22	15.5
Brookville	.....	.....	.....	2.20	14.8
Browers	.....	.....	.....	2.75	.....
Butler	48	0	23.0	2.10	16.0
California	55	— 1	28.4	1.43	6.8
Cassandra	43	— 1	22.4	2.71	22.0
Centerhall	43	— 2	24.0	1.84	7.6
Clarion	.....	.....	.....	2.07	13.0
Coatesville	50	9	28.9	4.16	10.9
Confluence	.....	.....	.....	1.54	0.9
Davis Island Dam	.....	.....	.....	0.92	4.0
Derry	52	— 1	24.6	1.62	14.8
Doylestown	.....	.....	.....	4.31	.....
Dushore	43	— 14	21.6	3.48	20.6
East Bloomsburg	.....	.....	.....	1.80	1.0
East Mauch Chunk	48	— 5	25.3	4.03	17.6
Easton	51	5	27.4	3.62	11.5
Ellwood Junction	.....	.....	.....	2.18	12.0
Emporium	42	— 4	24.2	3.88	17.1
Ephrata	47	5	27.6	2.70	8.8
Everett	50	5	25.2	1.15	11.5
Forks of Neshaminy	.....	.....	.....	3.67	.....
Franklin	60	— 8	24.6	2.07	11.0
Freeport	44[d]	0[d]	23.2[b]	2.55	12.1
Gettysburg	44	9	29.3	2.16	13.5
Girardville	.....	.....	.....	4.93	33.5
Gordon	45	— 5	24.0	4.78	23.0
Greensboro	.....	.....	.....	1.12	5.5
Greenville	49	— 7	23.2	2.87	18.8
Hamburg	46	— 7	26.2	3.37	6.0
Herrs Island Dam	.....	.....	.....	1.57	5.5
Huntingdon *a*	.....	.....	.....	1.16	6.0
Huntingdon *b*	49	2	27.2	1.40	7.0
Indiana	45	— 3	22.8	.....	.....
Irwin	49	1	25.6	1.72	4.0
Johnstown	45	4	26.4	2.42	10.8
Keating	.....	.....	.....	1.29	3.6
Kennett Square	50	9	29.4	4.38	8.0
Lansdale	.....	.....	.....	4.04	.....
Lawrenceville	42[d]	— 11[d]	21.0[d]	1.92	16.0
Lebanon	46	0	27.2	3.15	11.0
Leroy	40	— 5	21.6	2.60	10.5
Lewisburg	48	— 9	25.8	2.00	18.6
Lockhaven *a*	44	1	25.5	2.37	12.8
Lockhaven *b*	.....	.....	.....	1.52	9.0
Lock No. 4	.....	.....	.....	1.67	6.7
Lycippus	52	2	24.8	2.48	18.4
Marion	44	9	27.6	1.81	7.5
Mifflin	.....	.....	.....	3.40	6.5
Mifflintown	46	3	26.5	1.45	9.8
Milford	47	— 7	22.1	3.51	24.5
Montrose	41	— 7	20.4	2.64	24.2
New Germantown	48	5	28.1	1.92	4.3
Oil City	.....	.....	.....	2.82	16.4
Ottsville	.....	.....	.....	4.64	.....
Parker	.....	.....	.....	1.80	10.3
Philadelphia	53	12	32.4	3.67	6.8
Pocono Lake	45	— 12	20.6	3.83	20.0
Point Pleasant	.....	.....	.....	4.46	.....
Pottsville	.....	.....	.....	3.54	.....
Quakertown	57	5	27.6	3.12	1.4
Reading	48	3	28.4	3.94	.....
Renovo *a*	42	1	26.1	1.97	14.5
Renovo *b*	.....	.....	.....	1.56	9.9
Saegerstown	48	— 14	22.3	2.61	17.7
St. Marys	38	— 3	20.4	3.35	23.0
Saltsburg	.....	.....	.....	1.88	11.9
Seisholtzville	.....	.....	.....	4.52	.....
Selinsgrove	46	1	26.5	3.98	23.0
Shawmont	.....	.....	.....	4.11	.....
Skidmore	45	— 1	22.5	.....	.....
Smethport	48	— 10	19.1	1.61	20.5
Smiths Corners	.....	.....	.....	3.50	.....
Pennsylvania—Cont'd.					
Somerset	50	0	22.6	2.54	12.4
South Eaton	45	— 6	25.2	3.85	10.5
Springmount	.....	.....	.....	2.70	.....
State College	43	1	24.2	1.67	8.1
Sunbury	.....	.....	.....	2.15	18.0
Swarthmore	51	9	29.8	3.70	6.0
Towanda	44	— 9	23.6	2.42	14.7
Troutrun	.....	.....	.....	2.50	26.0
Uniontown	48	— 3	25.2	1.81	9.5
Warren	45	— 2	23.0	2.00	16.4
Wellsboro	48	0	25.6	1.35	13.5
Westchester	50	9	29.4	4.19	7.0
West Newton	.....	.....	.....	2.36	10.0
Wilkesbarre	48	— 2	26.2	3.06	16.0
Williamsport	44	2	26.6	2.85	18.5
York	48	7	29.2	2.90	15.2
Rhode Island.					
Bristol	50	6	29.5	3.08	8.0
Kingston	52	— 3	25.6	3.77	9.0
Pawtucket	53	0	28.6	3.85	4.0
Providence *a*	55	5	29.6	3.56	8.0
Providence *c*	54	0	27.6	3.33	5.0
South Carolina.					
Aiken	62	17	42.3	2.06	
Allendale	58	18	43.0	1.47	
Anderson	61	17	40.6	1.89	
Barksdale	60	17	39.2	0.57	T.
Batesburg	67	19	41.8	2.73	0.2
Beaufort	69	26	47.0	2.05	
Bennettsville	72	18	42.0	1.90	
Blackville	67	21	40.8	2.31	
Bowman	65	19	42.3	2.19	T.
Calhoun Falls	.....	.....	.....	1.41	
Camden	.....	.....	.....	1.91	T.
Cheraw *a*	64	18	39.0	2.16	.....
Cheraw *b*	.....	.....	.....	2.22	T.
Clarks Hill	63	18	41.6	1.98	
Clemson College	53	14	38.9	2.10	T
Conway	68	17	41.2	3.35	0.6
Darlington	66[e]	16	41.0[e]	2.09	
Due West	61	17	41.6	1.72	T.
Effingham	.....	.....	.....	2.63	T.
Florence	68	19	40.4	2.32	.....
Gaffney	66	16	37.4	1.45	0.6
Georgetown	65	26	45.8	5.10	
Gillisonville	72	22	43.5	1.69	T.
Greenville	59	14	34.9	2.32	1.0
Greenwood	59	19	38.2	1.14	
Heath Springs	65	15	37.8	1.70	
Kingstree *a*	65	22	41.6	2.49	1.3
Kingstree *b*	.....	.....	.....	2.37	1.3
Liberty	61	16	38.4	2.27	1.2
Little Mountain	69	18	41.8	1.91	T.
Longshore	63	17	40.2	1.41	T.
Lugoff	65	16	40.4	1.91	T.
Pinopolis[g]	66	24	42.0	3.41	
St. Georges	65	23	42.0	2.71	1.0
St. Matthews	65	24	42.1	2.71	0.5
St. Stephens	.....	.....	.....	2.95	
Saluda	63	18	40.0	1.80	T
Santuck	67	15	38.2	1.60	T.
Seivern	65	18	39.7	2.28	
Smiths Mills	.....	.....	.....	3.48	1.1
Society Hill	60	19	40.2	2.08	T.
Spartanburg	60	10	36.7	1.82	T.
Statesburg	65	20	43.2	2.02	
Summerville	69	20	43.6	2.60	T.
Trenton	60	18	40.8	2.37	0.7
Trial	66	15	40.6	3.08	
Walhalla	63	14	40.8	2.92	
Walterboro	72	23	45.9	2.40	
Winnsboro	61	22	41.3	1.34	
Winthrop College	60	17	38.4	1.93	T.
Yemassee	68	23	43.3	2.26	
Yorkville	62	18	41.0	2.17	T.
South Dakota.					
Aberdeen	45	— 25	15.3	1.86	9.2
Academy	50	— 18	22.0	0.85	8.6
Alexandria	42	— 29	16.6	0.85	8.5
Armour	49	— 18	20.8	0.40	4.0
Ashcroft	65	— 14	27.6	0.60	6.0
Bowdle	48	— 23	15.0	0.60	6.0
Brookings	42	— 27	12.5	0.45	4.5
Canton	48	— 29	17.4	0.28	6.0
Centerville	.....	.....	.....	0.71	6.4
Chamberlain	50	— 22	20.2	0.53	8.0
Cherrycreek	51	— 28	21.0	0.30	2.8
Clark	42	— 23	11.9	1.14	10.2
Clear Lake	37	— 22	13.0	1.05	
Doland	44	— 33	12.0	0.99	8.5
Elkpoint	52	— 16	21.0	0.22	4.2
Fairfax	48	— 9	25.2	.....	.....
Farmingdale	.....	.....	.....	0.46	3.0
Faulkton	43	— 19	15.8	0.37	7.3
Flandreau	42	— 28	14.5	0.52	5.2
Forestburg	47	— 34	13.6	0.92	9.2
Fort Meade	62[b]	— 12	30.7[d]	0.81	8.1
Gannvalley	44	— 27	16.4	0.55	9.0

TABLE II.—*Climatological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
South Dakota—Cont'd.	°	°	°	*Ins.*	*Ins.*
Gettysburg	50	— 22	16.6	1.71	12.5
Grand River School	48	.....	.....	0.15	3.3
Greenwood	54	— 10	25.2	0.31	3.1
Highmore	44	— 21	17.4	0.63	6.0
Hotch City	48	— 22	19.4	0.34	5.0
Howard	41	— 25	15.4	1.08	10.8
Howell	45	— 26	14.6	0.27	3.0
Ipswich	44	— 25	13.4	0.59	4.0
Kidder	37	— 26	11.6	0.30	.....
Kimball	43	— 17	18.6	0.85	8.0
Leola	42	— 21	15.2	0.30	5.5
Marion	44	— 20	16.0	0.44	7.0
Mellette	44	— 25	13.8	0.56	5.6
Menno	47	— 21	18.2	0.50	4.2
Mitchell	41	— 23	16.0	0.95	2.0
Oelrichs	58	— 9	27.2	0.25	2.5
Pedro	53	— 11	25.6	0.29	3.0
Pine Ridge	60	— 13	27.6	0.09	1.5
Plankinton	44	— 27	16.8	0.85	8.5
Ramsey	45	.....	.....	0.70	9.5
Redfield	45	— 27°	12.1°	0.27	3.2
Rosebud	60°	— 12°	26.4°	1.55	12.1
Silver City	.....	.....	.....	1.30	13.0
Sioux Falls	46	— 28	13.7	0.56	5.5
Sisseton Agency	38	— 20	13.2	0.23	1.3
Spearfish	59	— 5	32.4	1.50	16.0
Stephan	44	— 27	15.5	0.68	6.1
Tyndall	44	— 19	20.8	1.22	9.2
Watertown	46	— 23	11.9	0.43	6.5
Wentworth	44	— 25	13.9	0.88	8.3
Wolsey	.....	.....	.....	0.95	10.2
Tennessee.					
Andersonville	51	9	31.0	2.40	1.5
Ashwood	61	10	36.4	3.47	0.5
Bluff City	.....	.....	.....	1.64	0.6
Bolivar	65	14	35.9	4.72	T.
Bristol	49	10	30.6	1.75	T.
Byrdstown	53	8	33.4	4.12	4.1
Carthage	58	9	33.7	4.00	0.2
Catlettsburg	.....	.....	.....	2.03	0.4
Celina	.....	.....	.....	4.01	0.3
Charleston	.....	.....	.....	2.04	.....
Clarksville	58	8	34.6	4.14	0.9
Clinton	.....	.....	.....	3.20	1.0
Covington	58	17	37.2	4.68	.....
Decatur	56	10	34.2	2.68	0.5
Dickson	55[b]	8[b]	33.0[b]	4.15	0.3
Dover	61	9	35.1	3.20	T.
Elizabethton	58	6	33.4	1.56	2.5
Erasmus	57	5	29.6	3.81	1.8
Florence	55	10	35.0	4.12	1.0
Franklin	55	10	34.6	3.75	T.
Grace[*1]	52	10	34.0	3.70	2.0
Greeneville	58	12	33.2	2.41	2.0
Halls Hill	.....	.....	.....	4.03	T.
Harriman	53	11	32.5	2.95	1.0
Hohenwald	61	5	35.2	5.27	0.5
Iron City	60	11	35.0	4.94	1.0
Isabella	55	13	33.2	1.76	1.7
Jackson	62	10	36.7	4.53	.....
Johnsonville	61	10	35.1	4.82	T.
Jonesboro	60	7	32.2	1.92	6.0
Kenton	60	12	36.2	4.71	0.1
Kingston	.....	.....	.....	2.91	1.5
Lafayette	56	5	31.6	4.44	1.6
Leadvale	.....	.....	.....	2.20	T.
Lewisburg	60	11	35.9	4.12	1.0
Liberty	59	9	32.9	4.22	0.2
Lynnville	57	10	35.7	4.27	0.5
McMinnville	57	9	34.0	4.04	2.5
Maryville	58	13	35.2	2.41	1.0
Newport	56	13	33.6	2.20	1.0
Palmetto	57	10	35.0	4.12	T.
Pope	62	11	36.4	4.77	.....
Rogersville	52	10	32.7	2.39	1.3
Rugby	57	5	30.4	3.69	2.0
Savannah	62	13	37.7	4.85	T.
Sewanee	53	6	33.3	1.61	0.8
Silverlake	55	2	28.0	2.75	7.7
Springdale	53	10	30.4	3.45	T.
Springville	61	10	35.2	4.75	0.2
Tazewell	.....	.....	.....	3.44	2.1
Tellico Plains	60	12	36.2	1.83	T.
Trenton	63	12	37.4	5.45	2.2
Tullahoma	56	10	34.2	3.59	0.2
Waynesboro	67	10	37.6	4.28	T.
Wildersville	58	12	37.0	4.95	T.
Yukon	59	11	36.8	3.57	T.
Texas.					
Albany	72	16	46.5	0.00	
Alvin	77	32	53.3	3.63	
Arthur	.....	.....	.....	2.20	
Austin[a]	75	28	52.6	1.35	
Ballinger	73	22	46.2	0.24	
Beaumont	.....	.....	.....	4.03	
Beeville	81	33	54.4°	1.45	
Bigspring	75	15	45.8	T.	
Blanco	73	25	49.2	0.66	

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Texas—Cont'd.	°	°	°	*Ins.*	*Ins.*
Boerne[*1]	76	27	50.4	0.75	
Bonham	66	22	46.8	1.01	
Booth	.....	.....	.....	3.17	
Bowie	71	19	45.6	0.50	
Brenham	74	30	52.4	4.80	
Brighton	82	32	57.2	0.95	
Brownwood	75	25	48.4	0.30	
Burnet	74	22	50.8	0.85	
Camp Eagle Pass	81	21	53.3	0.40	
Childress	70	16	44.6	0.00	
Coleman	79[d]	26°	50.4[d]	0.43	
College Station	75	29	53.4	3.17	
Colorado	76[f]	13	45.9[e]	0.00	
Columbia	77	29	55.0	6.04	
Columbus	.....	.....	.....	0.75	
Comstock	76	32	54.6	0.10	
Corsicana	78	24	49.5	0.81	
Cotulla	92	31	59.6	0.00	
Cuero	78	31	52.4	1.50	
Dallas	73	22	47.0	0.60	
Danevang	76	30	53.8	4.68	
Dialville	69	25	48.6	2.13	
Dublin	75	23	48.1	0.25	
Duval	74	28	52.7	1.04	
Estelle	72	21	48.2	0.46	
Fort Brown	83	40	60.9	0.50	
Fort Clark	77	28	49.6	0.01	
Fort Davis	71	16	43.6	0.07	T.
Fort McIntosh	84	30	56.4	T.	
Fort Ringgold	87	31	57.4	0.40	
Fort Stockton	.....	.....	.....	0.00	
Fredericksburg	73	26	49.7	1.17	
Gainesville	68	17	43.9	0.43	T.
Gatesville	75	28	50.8	0.30	
Grapevine	.....	.....	.....	0.91	
Greenville	73	23	46.3	0.85	
Hale Center	73	17	43.6	0.00	
Hallettsville	78	31	55.0	1.15	
Haskell	79	18	47.7	0.00	
Hearne	73	34[d]	57.0[b]	3.10	
Hempstead	.....	.....	.....	2.20	
Henrietta	71	20	46.4	0.18	
Hewitt	.....	.....	.....	0.27	
Hillsboro	70	21	47.8	0.31	
Hondo	71	32	52.8	0.65	
Houston	75	34	52.6	2.36	
Huntsville	.....	29°	.....	3.83	
Ira	78	18°	47.4°	T.	
Jasper	83	28	54.2	3.20	
Jefferson	73	20	45.8	2.93	
Junction	.....	.....	.....	0.01	
Kaufman	69	23	47.9	0.29	
Kent	72	16	44.9	0.27	
Kerrville	75	40	58.1	1.18	
Kopperl	.....	.....	.....	0.00	
Lampasas	74	23	48.6	0.48	
Lapara	.....	.....	.....	0.29	
Laureles Ranch	.....	.....	.....	0.00	
Liberty	.....	.....	.....	1.60	
Llano	75	20	50.4	0.25	
Longview	70	22	47.0	2.73	
Luling	76	29	50.8	1.32	
Mount Blanco	74	10	41.8	0.00	
Nacogdoches	74	22	47.1	5.17	
New Braunfels	74	32	54.0	1.82	
Orange	.....	.....	.....	0.60	
Panter	.....	.....	.....	0.43	
Paris	76	20	44.6	0.93	
Pearsall	79	32	56.5	0.21	
Port Lavaca	76	35	56.0	3.08	
Rhineland	78	12	44.4	0.00	
Riverside	.....	.....	.....	4.22	
Rockisland	75	30	53.8	1.35	
Rockland	.....	.....	.....	3.71	
Rockport	72	44	58.4	1.82	
Runge	78°	31°	55.0°	0.75	
Sabinal	87	28	57.6	0.17	
Sabine	77	32	52.6	4.37	
San Saba	75	21	49.4	0.09	
Santa Gertrudes Ranch	.....	.....	.....	0.00	
Sherman	73	25	49.3	1.18	
Sonora	71	17	47.8	0.14	
Sugarland	78	30	54.1	2.85	
Sulphur Springs	72	22	46.4	1.00	
Temple[a]	68	23	47.2	1.53	
Temple[b]	72	25	48.8	2.24	
Tilden	83	20	54.6	T.	
Trinity	72	26	50.7	3.55	
Tulia	71	11	40.3	0.00	
Tyler	70	25	46.3	1.34	
Victoria	79	33	55.8	3.68	
Waco	78	27	50.8	0.18	
Waxahachie	72	21	46.6	0.23	
Weatherford	70	23	46.0	0.62	
Wichita Falls	.....	.....	.....	0.50	
Utah.					
Alpine	.....	.....	.....	0.45	4.5
Aneth	63	3	27.4	0.02	0.2

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Utah—Cont'd.	°	°	°	*Ins.*	*Ins.*
Blackrock	52	— 2	25.2	0.18	1.8
Bluecreek	45	0	25.7	0.20	2.0
Callao	48	— 4	24.1	0.07	1.5
Castledale	63°	—15°	22.4°	0.00	
Corinne	48	1	25.4	0.90	9.0
Coyoto	60	— 6	24.2	T.	T.
Deseret	57	— 4	25.4	0.05	0.5
Emery	59	0	25.8	0.00	
Escalante	56	5	28.1	0.00	
Farmington	45	7	27.6	1.37	13.2
Fillmore	62	8	31.6	0.40	
Fort Duchesne	44°	— 3°	18.2°	0.00	
Frisco	60	13	33.0	0.07	
Garrison	59	0	27.0	T.	
Government Creek	.....	5	.....	0.09	0.9
Green River	53	0	23.8	0.01	0.1
Grover	66	5	29.0	T.	T.
Heber	50	— 8	21.6	1.33	13.3
Henefer	54	—10	22.4	1.23	14.0
Hite	62	14	34.6	0.00	
Huntsville	.....	.....	.....	1.23	14.0
Ibapah	55	—10	23.2	0.15	1.5
Levan	49	2	24.2	0.52	5.4
Loa	60	—10	25.6	0.00	
Logan	39	0	24.0	0.68	
Lund	52	2	27.1	T.	T.
Manti	50	5	26.0	0.40	4.0
Marysvale	58	0	27.8	0.52	1.4
Meadowville	43	9	23.8	0.20	2.0
Millville	.....	.....	.....	0.76	
Moab	58	6	28.4	0.05	T.
Monticello	51	9	29.2	0.00	
Morgan	50	—10	21.6	1.03	13.0
Mount Nebo	51	6	27.6	0.23	
Mount Pleasant	52	7	28.6	0.20	2.0
Ogden	40	9	26.8	0.95	14.5
Park City	50	8	27.2	1.45	14.5
Parowan	57	5	27.2	0.53	5.8
Pinto	62	— 9	27.5	0.21	0.9
Plateau	62	—26	22.8	1.22	4.7
Promontory[*1]	54	0	21.8	0.25	2.5
Provo	46	10	28.4	0.49	2.7
Ranch	68	2	30.4	T.	T.
Richfield	57	3	26.1	0.04	0.4
St. George	65	5	33.6	0.07	
Salt Air	42	8	27.6	0.43	5.2
Scipio	60	— 6	26.2	0.33	3.0
Snowville	46	— 4	24.8	1.00	10.0
Terrace	45	8	26.3	T.	T.
Thistle	55	— 2	31.6	1.40	14.0
Tooele	46	11	28.0	0.95	.....
Tropic	76	0	30.8	T.	T.
Wellington	60°	4°	24.2°	0.95	0.5
Woodruff	67[d]	— 9[d]	19.8[d]	T.	T.
Vermont.					
Burlington	41	— 4	20.8	1.42	9.0
Cavendish	46	—10	19.6	2.88	11.8
Chelsea	42	—18	14.4	2.08	23.0
Cornwall	48	— 9	19.3	0.85	4.0
Derby	44	—15	12.4	.....	
Enosburg Falls	48	—22	15.2	2.27	16.5
Jacksonville	42	—10	14.9	3.68	38.3
Manchester	48	—10	20.2	1.92	18.0
Morrisville	46	—24	15.4	2.91	23.5
Norwich	44	—17	15.9	3.69	19.0
St. Johnsbury	46	—18	17.2	2.27	13.4
Wells	46	— 8	18.4	2.65	12.5
Woodstock	55	—16	21.2	3.22	21.0
Virginia.					
Ashland	55	12	33.0	2.87	T.
Barboursville	51	12	34.1	1.50	2.8
Bedford	50	12	33.2	.....	
Bigstone Gap	49	6	31.2	3.85	3.0
Blacksburg	54	1	28.4	1.25	4.0
Boykins	.....	.....	.....	0.90	
Buckingham	56	10	33.1	1.96	1.5
Burkes Garden	46	— 2	25.4	2.17	3.0
Callaville	59	13	37.6	2.08	
Charlottesville	59	9	33.4	1.54	1.0
Clarksville	.....	.....	.....	2.05	T.
Columbia	.....	.....	.....	1.69	1.0
Dale Enterprise	51	5	28.6	1.15	4.0
Danville	.....	.....	.....	1.85	T.
Elk Knob	45	6	29.9	4.21	2.5
Farmville	54	12	33.2	2.00	T.
Fredericksburg	53	8	32.2	1.84	2.0
Hampton	58	16	37.4	2.20	T.
Hot Springs	48	5	26.2	1.40	4.5
Lexington	59	3	31.5	1.37	4.8
Lincoln	48	8	28.7	1.62	1.2
Marion	54°	— 4°	28.8°	2.55	3.5
McDowell	50	0	28.0	0.42	4.2
Mendota	.....	.....	.....	2.46	1.2
Newport News	60	15	37.0	2.65	T.
Petersburg	58	15	35.2	2.52	T.
Quantico	56	10	33.4	.....	.....
Radford	.....	.....	.....	0.80	6.0
Riverton	.....	.....	.....	0.15	0.5

TABLE II.—*Climatological record of voluntary and other cooperating observers*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Virginia—Cont'd.	°	°	°	*Ins.*	*Ins.*
Roanoke				1.25	1.2
Rockymount	50	10	28.8	1.98	0.5
Saxe	56	8	33.7	2.38	
Shenandoah				0.78	2.6
Speers Ferry				2.42	3.0
Spottsville	58	12	35.5	2.49	0.2
Staunton	50	10	31.6	1.31	5.0
Stephens City	52	8	30.3	1.21	4.0
Warsaw	54[f]	16[f]	33.0[f]	2.35	
Wilkerson	54	11	33.9	2.41	2.5
Woodstock	52	9	30.5	0.76	3.6
Wytheville	56	— 1	30.6	1.32	3.0
Washington.					
Aberdeen	54	30	42.4	9.53	
Anacortes				2.88	
Ashford				5.75	
Blaine	55	27	40.0	4.06	
Brinnon	57	31	40.8	5.73	
Cedonia	42	16	27.2	2.02	6.0
Centralia	57	23	40.3	3.82	
Cheney				2.46	21.0
Clearbrook	54	23	38.8	6.09	
Clearwater	54	29	41.0	11.21	
Cle Elum	47	13	29.4	1.42	6.0
Colville	45	12	28.5	1.95	8.0
Conconully	42	12	27.0	1.12	2.0
Coupeville	63	30	43.0	1.58	
Crescent	44	12	28.4	2.11	4.5
Danville	50	14	28.0	1.45	9.7
Dayton	63	20	34.0	1.78	4.5
East Sound	56	26	41.2	2.90	
Ellensburg	48	15	29.4	0.41	2.5
Ephrata	50	12	29.2	0.85	4.0
Grandmound	55	20	40.0	4.25	
Granite Falls				4.37	
Horseheaven				0.86	3.4
Lacenter	53	23	39.2	4.58	
Lakeside	46	4	24.9	0.35	3.5
Lind	45	15	29.7	2.00	7.5
Loomis	48	12	29.0	0.60	
Mayfield	50[f]	30[b]	39.7[g]	5.24	
Mottinger Ranch	55	23	34.6	0.81	1.0
Mount Pleasant	52	28	38.8	5.14	
Moxee	53	13	30.0	0.39	1.3
Northport	43	13	29.3	1.02	9.5
Odessa	49	12	29.0	1.15	3.3
Olga	52	32	43.0	2.52	
Olympia	59	24	42.0	4.80	
Pinehill	53	24	34.4	1.59	1.0
Pomeroy	60	17	33.4	0.90	2.8
Port Townsend	54	33	42.8	1.17	
Pullman	54	19	32.6	1.83	4.5
Rattlesnake	51	12	29.3	0.80	3.0
Republic	46	9	26.0	1.22	6.2
Ritzville (near)				1.35	4.1
Rosalia	52	17	31.0	1.80	3.0
Sedro-Woolley	61	26	41.2	4.83	
Silvana	56	26	39.0	2.01	
Snohomish	56	25	40.0	4.92	
Snoqualmie	56	28	40.4	8.16	
Southbend	58	30	42.8	8.66	
South Ellensburg	46	14	28.2	0.20	2.0
Sprague				2.50	4.0
Sunnyside	53	16	30.8	0.24	0.5
Trinidad	50	17	30.2	1.05	2.5
Twisp	44	5	21.8	1.55	15.5
Union	56[i]	25[b]	41.6[h]	7.72	
Usk	44	15	29.6	2.42	8.2
Vancouver	53	24	39.2	2.77	
Vashon	54	32	42.0	4.92	
Waterville	42	10	22.9	1.67	11.5
Wenatchee (near)	49	16	26.6	1.01	5.5
Whatcom	60	25	41.8	3.13	
Wilbur	42	15	27.3	1.63	5.0
Zindel	63	23	39.5	0.55	1.5
West Virginia.					
Bayard	53	— 3	22.8	2.26	
Bens Run	50	0	25.4	2.50	8.0
Beverly	48	— 2	22.2	2.39	21.3
Bluefield	47	0	28.2	1.94	19.4
Buckhannon	55	0	24.5	4.43	6.5
Burlington	52	4	27.4	0.86	4.0
Cairo	53	0	25.0	2.30	6.5
Central	53	— 4	25.4	2.17	9.2
Charleston				2.12	2.4
Creston	52	0	24.5	2.00	5.0
Cuba	53	— 6	25.9	1.57	4.5
Elkhorn	52	3	29.7	1.54	3.8
Fairmont				1.80	4.4
Glenville	56	1	25.2	3.25	7.9
Grafton	58	1	26.4	2.28	12.5
Green Sulphur Springs	50	0	26.8	0.61	1.0
Harpers Ferry				0.69	1.8
Hinton	50	3	28.8	1.33	1.5
Huntington	52	7	27.5	1.74	2.0
Leonard	46	— 1	21.8	3.50	9.0
Lewisburg	44	5	26.4	1.01	3.0
Lillydale	59	2	28.0	1.13	1.3
Logan	56	5	32.6	3.32	5.0
Lost Creek	50	— 2	26.6	2.46	9.5
Magnolia[d]	60	19	38.4		
Mannington	52	— 8	25.8	1.68	5.0
Marlinton	43	—11	22.4	2.44	12.0
Martinsburg	49	8	28.2	1.25	1.0
Moorefield	54	— 3	29.6	0.30	2.5
Morgantown	56	5	27.2	1.70	13.0
Moscow	50	4	24.8	2.15	2.0
Moundsville	50	0	26.6	2.73	7.0
New Martinsville	45	1	27.1	2.37	7.0
Nuttallburg	45	12	29.4	1.45	
Parsons	54	1	24.5	2.05	6.5
Philippi	56	— 4	25.1	2.46	10.3
Pickens	55	1	24.8	3.30	33.0
Point Pleasant	53	5	27.0	1.68	1.0
Powellton	56	0	26.6	0.89	3.0
Princeton	46	4	28.2	2.95	12.0
Romney	58	5	26.9	0.40	1.0
Rowlesburg				3.09	14.2
Ryan	55	— 7	36.1	1.89	10.0
Southside	56	9	29.7	1.67	6.2
Spencer	55	2	27.7	2.06	4.5
Terra Alta	52	0	22.5	3.70	11.0
Travellers Repose	50	—10	20.8	1.76	10.0
Uppertract	55	4	29.1	0.51	1.5
Valley Fork	55	4	27.8	3.22	8.3
Webster Springs	57	3	26.2	1.20	9.9
Wellsburg	45	1	23.8	2.35	12.0
Weston				2.74	11.7
Wheeling[a]				1.36	12.6
Wheeling[b]	53	8	29.2		
Williamson	56	5	31.2	1.38	
Wisconsin.					
Amherst	36	—21	12.2	1.25	12.5
Antigo	38	—23	11.2	0.40	4.0
Appleton	36	—21	16.0	0.46	3.5
Appleton Marsh	38	—25	12.5	1.04	11.8
Ashland				1.12	
Barron	34	—26	8.0	0.54	5.4
Beloit	41	—25	15.2	2.17	21.0
Brodhead	41	—22	16.0	1.91	16.5
Burnett	40	—22	13.3	0.46	5.3
Butternut	31	—28	7.2	1.27	12.7
Chilton	38	—21	11.9	0.89	8.6
Citypoint	37	—25	10.7	0.73	7.5
Darlington	42	—30	13.2	1.25	12.5
Dodgeville[c]	44	—22	18.0	0.65	6.5
Downing	35	—25	10.4	0.80	8.0
Easton	39	—25	11.0	0.61	11.7
Eau Claire	37	—22	10.7	0.84	8.4
Florence	33	—20	11.8	0.85	8.5
Fond du Lac	40	—21	16.4	0.37	
Grand Rapids	36	—32	10.0	0.77	7.9
Grand River Locks				0.84	14.5
Grantsburg	32	—25	6.9	1.50	15.0
Hancock	36	—25	12.0	1.09	13.0
Harvey	37	—19	15.2	1.02	10.1
Hayward	32	—30	5.0	1.05	10.5
Hillsboro	43	—30	11.9	1.35	13.5
Koepenick	35	—25	11.2	0.80	8.5
Lancaster	43	—22	13.4	0.65	13.5
Madison	37	—18	16.2	0.60	17.8
Manitowoc	38	—19	17.3	0.44	7.9
Meadow Valley	37	—29	11.0	0.55	10.5
Medford	44	—25	10.8	0.50	5.0
Menasha				0.23	6.5
Minocqua	33	—25	9.9	0.58	7.0
Neillsville	34	—27	10.4	0.85	2.0
New London	37	—24	12.6	0.72	7.5
Osceola	33	—31	8.6	0.83	10.0
Oshkosh	39	—23	15.0	0.63	10.5
Pine River	39	—23	14.0	0.67	13.7
Portage	42	—20	15.9	0.50	11.0
Port Washington	40	—22	13.2	0.89	8.0
Prairie du Chien[a]	50	—18	19.1	0.53	9.4
Prairie du Chien[b]				0.49	6.0
Prentice	33	—27	8.0	0.67	4.0
Racine	41	—17	18.8	0.76	7.6
Sheboygan	40	—16	18.6	1.05	10.5
Spooner	38	—26	7.8	0.88	8.8
Stanley	34	—27	10.1	0.78	8.7
Stevens Point	36	—26	11.4	0.94	9.7
Valley Junction	39	—24	13.6	0.48	8.5
Viroqua	38	—27	12.4	1.05	11.2
Washburn	32	—22	12.8	1.25	12.3
Watertown	42	—21	14.8	1.64	15.2
Waukesha	38	—17	16.0	0.99	13.3
Waupaca	36	—23	11.4	0.59	10.0
Wausau	35	—24	9.7	0.60	
Whitehall	36	—29	10.8	0.84	8.4
Wyoming.					
Afton	47	—12	19.8	0.80	8.0
Alcova	55	0	28.3	0.20	2.0
Basin	55	— 3	22.2	0.06	
Battle	32	— 2	14.0		
Bedford	47	—13	18.4	1.00	10.0
Border	40	—21	12.5	0.15	
Buffalo	60	— 3	28.2	0.12	1.0
Chugwater	57	— 2	31.5	0.40	1.5
Daniel	37	— 9	16.4	0.10	1.0
Evanston	49	— 3	22.9	0.30	2.5
Fontenelle	45	— 9	17.4	T.	T.
Fort Laramie	61	— 4	30.4	0.18	3.0
Fort Washakie	65	— 9	25.1	0.50	5.0
Fort Yellowstone	45	2	24.5	1.30	13.0
Fourbear	58	— 2	28.4	0.25	4.0
Griggs	60	— 8	29.6	0.46	4.6
Hotsprings	52	—14	21.4	0.70	7.0
Hyattville	58	— 5	26.7		
Irma	58	3	34.5	0.40	4.0
Laramie	52	— 4	26.4	0.07	1.1
Leo	48	— 7	24.6	0.19	2.2
Lolabama Ranch	47	— 9	25.9		
Lusk	58	—14	27.6	0.38	3.8
Moore	54	— 2	31.4	0.07	4.0
Moorcroft	50	— 8	25.0	1.00	10.0
Phillips	65	— 3	32.8	0.01	T.
Rawlins	50	2	26.4	0.29	2.9
South Pass	43	—15	16.6	0.70	7.0
Ten Sleep	60	— 5	22.2	0.20	2.0
Thayne	48	—15	17.8	0.98	10.9
Porto Rico.					
Adjuntas	88	53	71.8	6.40	
Aguirre	90	63	78.4	5.99	
Arecibo	87	54	71.9	7.90	
Barros	85	51	71.0	6.18	
Bayamon	92	60	77.2	4.30	
Caguas	87	59	74.4	5.83	
Canovanas	84	67	76.2	15.08	
Cayey	85	55	71.4	4.50	
Cidra	86	51	70.6	15.75	
Coamo	91	55	75.0	1.01	
Corozal[e]	90	55	72.4	7.98	
Fajardo	87	65	78.0	6.43	
Guanica	90	60	76.0	2.56	
Hacienda Colosa	90	61	75.8	4.01	
Hacienda Josefa				2.79	
Hacienda Perla	88	65	77.6	14.19	
Humacao	85	68	77.6	7.67	
Isabela	88	62	74.4	8.74	
La Isolina	86	60	73.6	13.25	
Lares	87	57	72.0	9.42	
Las Marias	93	64	76.8	6.95	
Manati	89	61	75.0	11.62	
Maunabo	90	62	75.8	7.97	
Mayaguez	89	62	76.1	4.56	
Morovis	88	60	72.5	15.45	
Ponce	87	61	76.4	1.54	
Rio Blanco	87	62	76.0	10.43	
Rio Piedras				10.89	
San German	95	61	78.0	3.50	
San Lorenzo	88	56	73.2	7.95	
San Salvador	84	60	71.8	6.38	
Santa Isabel	88	61	76.0	1.04	
Utuado	89	56	73.6	8.51	
Vieques	86	64	75.0	4.87	
Yauco	85	61	75.6	2.25	
Mexico.					
Ciudad P. Diaz	70	24	45.6	0.30	
Coatzacoalcos	82	53	68.9	9.87	
Durango	70	32	52.0	0.14	
Leon de Aldamas	74	34	58.2	T.	
Vera Cruz	81	56	70.7		
New Brunswick.					
St. John	47	— 4	20.9	3.46	14.8
Isthmus of Panama.					
Alhajuela	91	70	81.1	20.71	
Bohio				18.78	
Colon				15.79	
Gamboa				13.86	
La Boca	85	72	76.8	8.62	
West Indies.					
Columbia, Isle of Pines	87	50	68.2	1.85	

Late reports for November, 1903.

Alaska.					
Fort Yukon	12	—41	—12.6	0.26	2.6
Kenai	34	—27	14.6	0.78	13.2
Sunrise	38	—15	17.2	3.37	32.2
Wood Island	53	11	33.1	3.30	T.
Arkansas.					
Dodd City	77	10	43.2	0.86	
California.					
Bowman	68	23	44.0	31.27	2.0
Folsom				5.32	
Palmdale				0.00	
San Miguel Island	71	49	58.4	1.30	
Ventura	78	44	61.1	0.00	
Colorado.					
Cripple Creek				0.00	
Holyoke (near)[e]	77	— 7	36.3	0.38	T.

TABLE II.—*Climatological record of voluntary and other cooperating observers. Late reports for November*—Continued.

Stations.	Temperature. (Fahrenheit.) Maximum.	Minimum.	Mean.	Precipitation. Rain and melted snow.	Total depth of snow.
Connecticut.	°	°	°	*Ins.*	*Ins.*
Wallingford	.....	.....	.....	2.10	
Florida.					
De Land	85	27	62.3	.....	
Georgia.					
Alpharetta	74	15	47.5	2.58	T.
Idaho.					
Roosevelt [5]	60	0	27.0	2.95	10.0
Iowa.					
Belle Plaine	54	2	31.9	0.39	0.2
Leon	68	6	37.1	0.84	5.4
Mississippi.					
Leaksville	89	21	55.7	0.93	
Nebraska.					
Alma	68	2	39.0	.....	
New Mexico.					
Las Vegas	76	10	43.8	T.	T.
Los Lunas	72	17	41.7	0.00	
New Mexico—Cont'd.					
Taos [c]	72	7	43.0	0.00	
New York.					
Blue Mountain Lake	.....	.....	.....	2.05	3.8
North Carolina.					
Brewers	85	12	42.4	1.83	T.
Oregon.					
Bullrun	.....	.....	.....	12.07	1.0
Umatilla	65	27	42.7	2.02	0.2
South Dakota.					
Mitchell	70	1	30.8	0.27	T.
West Virginia.					
Williamson	78	11	41.2	2.40	4.6
Porto Rico.					
Coamo	96	60	77.0	3.85	
Hacienda Coloso	92	61	77.6	5.73	
Ponce	90	65	78.1	3.33	
Utuado	93	59	76.9	12.42	

EXPLANATION OF SIGNS.

[c] Extremes of temperature from observed readings of dry thermometer.

A numeral following the name of a station indicates the hours of observation from which the mean temperature was obtained, thus:

[1] Mean of 7 a. m. + 2 p. m. + 9 p. m. + 9 p. m. + 4.
[2] Mean of 8 a. m. + 8 p. m. + 2.
[3] Mean of 7 a. m. + 7 p. m. + 2.
[4] Mean of 6 a. m. + 6 p. m. + 2.
[5] Mean of 7 a. m. + 2 p. m. + 2.
[6] Mean of readings at various hours reduced to true daily mean by special tables.

The absence of a numeral indicates that the mean temperature has been obtained from daily readings of the maximum and minimum thermometers.

An italic letter following the name of a station, as "Livingston *a*," "Livingston *b*," indicates that two or more observers, as the case may be, are reporting from the same station. A small roman letter following the name of a station, or in figure columns, indicates the number of days missing from the record; for instance "[n]" denotes 14 days missing.

No note is made of breaks in the continuity of temperature records when the same do not exceed two days. All known breaks, of whatever duration, in the precipitation record receive appropriate notice.

TABLE III.—*Resultant winds from observations at 8 a. m. and 8 p. m., daily, during the month of December, 1903.*

Stations.	Component direction from—				Resultant.	
	N.	S.	E.	W.	Direction from—	Duration.
New England.	*Hours.*	*Hours.*	*Hours.*	*Hours.*	°	*Hours.*
Eastport, Me	20	9	8	39	n. 70 w.	33
Portland, Me	16	22	2	33	s. 79 w.	32
Concord, N. H.†	9	8	5	15	n. 84 w.	10
Northfield, Vt	19	34	3	14	s. 36 w.	19
Boston, Mass	14	18	3	41	s. 84 w.	38
Nantucket, Mass	17	11	8	40	n. 79 w.	33
Block Island, R. I	20	14	5	35	n. 79 w.	31
Narragansett, R. I.*	5	7	3	22	s. 84 w.	19
New Haven, Conn	24	13	6	35	n. 73 w.	30
Middle Atlantic States.						
Albany, N. Y	21	29	8	19	s. 54 w.	14
Binghamton, N. Y.†	7	7	7	17	w.	10
New York, N. Y	16	13	6	37	n. 84 w.	31
Harrisburg, Pa	20	10	7	39	n. 73 w.	34
Philadelphia, Pa	25	18	5	35	n. 77 w.	31
Scranton, Pa	14	27	9	32	s. 61 w.	26
Atlantic City, N. J	22	10	4	40	n. 72 w.	38
Cape May, N. J	24	13	5	35	n. 70 w.	32
Baltimore, Md	20	12	6	38	n. 76 w.	33
Washington, D. C	27	16	6	29	n. 64 w.	26
Cape Henry, Va.†	12	8	4	13	n. 66 w.	10
Lynchburg, Va	17	18	8	36	s. 88 w.	28
Norfolk, Va	24	20	11	18	n. 60 w.	8
Richmond, Va	22	23	4	20	s. 87 w.	16
Wytheville, Va	7	13	6	46	s. 81 w.	40
South Atlantic States.						
Asheville, N. C	34	11	10	27	n. 36 w.	29
Charlotte, N. C	15	27	14	21	s. 30 w.	14
Hatteras, N. C	33	9	5	25	n. 40 w.	31
Kittyhawk, N. C.*						
Raleigh, N. C	24	18	7	27	n. 73 w.	21
Wilmington, N. C	23	15	6	28	n. 70 w.	23
Charleston, S. C	24	13	15	24	n. 39 w.	14
Columbia, S. C	15	20	16	26	s. 63 w.	11
Augusta, Ga	18	19	14	29	s. 86 w.	15
Savannah, Ga	23	12	13	25	n. 47 w.	16
Jacksonville, Fla	31	12	12	25	n. 34 w.	23
Florida Peninsula.						
Jupiter, Fla	31	9	13	20	n. 18 w.	23
Key West, Fla	40	4	33	7	n. 36 e.	44
Sand Key, Fla.†	18	4	15	2	n. 43 e.	19
Tampa, Fla	45	7	11	13	n. 3 w.	38
Eastern Gulf States.						
Atlanta, Ga	25	11	12	34	n. 58 w.	26
Macon, Ga.†	13	7	3	12	n. 56 w.	11
Pensacola, Fla.†	19	2	10	9	n. 3 e.	17
Birmingham, Ala.†	12	6	9	9	n.	6
Mobile, Ala	32	18	8	17	n. 33 w.	17
Montgomery, Ala	26	17	13	20	n. 38 w.	11
Meridian, Miss.†	14	5	8	11	n. 17 w.	10
Vicksburg, Miss	19	25	21	13	s. 53 e.	10
New Orleans, La	27	15	23	10	n. 47 e.	18
Western Gulf States.						
Shreveport, La	21	21	19	14	e.	5
Fort Smith, Ark	19	10	27	19	n. 42 e.	12
Little Rock, Ark	19	20	15	23	s. 83 w.	8
Corpus Christi, Tex	26	16	22	9	n. 52 e.	16
Fort Worth, Tex	22	23	11	23	s. 85 w.	12
Galveston, Tex	18	23	22	12	s. 63 e.	11
Palestine, Tex	21	25	10	19	s. 66 w.	10
San Antonio, Tex	25	20	17	15	n. 22 e.	5
Taylor, Tex.†	12	13	2	10	s. 83 w.	8
Ohio Valley and Tennessee.						
Chattanooga, Tenn	18	18	6	29	w.	23
Knoxville, Tenn	20	23	10	26	s. 79 w.	16
Memphis, Tenn	17	24	13	23	s. 55 w.	12
Nashville, Tenn	18	23	10	21	s. 66 w.	12
Lexington, Ky.†	5	11	5	14	s. 56 w.	11
Louisville, Ky	11	27	10	22	s. 37 w.	20
Evansville, Ind.†	11	10	4	10	n. 8 w.	6
Indianapolis, Ind	13	29	5	30	s. 57 w.	30
Cincinnati, Ohio	7	22	18	29	s. 36 w.	19
Columbus, Ohio	8	34	8	29	s. 39 w.	33
Pittsburg, Pa	22	14	5	37	n. 76 w.	33
Parkersburg, W. Va	10	28	5	30	s. 54 w.	31
Elkins, W. Va	14	15	1	43	s. 89 w.	42
Lower Lake Region.						
Buffalo, N. Y	5	20	9	37	s. 62 w.	32
Oswego, N. Y	14	28	13	25	s. 41 w.	18
Rochester, N. Y	2	26	7	38	s. 52 w.	39
Syracuse, N. Y	7	27	9	32	s. 49 w.	30
Erie, Pa	11	19	3	40	s. 78 w.	38
Cleveland, Ohio	4	42	8	23	s. 21 w.	41
Sandusky, Ohio†	4	13	2	21	s. 65 w.	21
Toledo, Ohio	6	32	5	35	s. 49 w.	40
Detroit, Mich	10	21	5	38	s. 72 w.	33
Upper Lake Region.						
Alpena, Mich	11	22	4	38	s. 72 w.	36
Escanaba, Mich	15	18	1	42	s. 86 w.	41
Grand Rapids, Mich	13	23	9	31	s. 66 w.	24
Houghton, Mich.†	10	8	6	15	n. 77 w.	9
Marquette, Mich	15	20	2	38	s. 82 w.	36
Port Huron, Mich	9	22	3	38	s. 70 w.	37
Sault Ste. Marie, Mich	16	20	26	19	s. 60 e.	8
Chicago, Ill	13	15	3	42	s. 87 w.	39
Milwaukee, Wis	10	12	2	49	s. 88 w.	47
Green Bay, Wis	12	26	3	39	s. 69 w.	39
Duluth, Minn	16	22	3	41	s. 81 w.	38
North Dakota.						
Moorhead, Minn	22	19	12	26	n. 78 w.	14
Bismarck, N. Dak	39	8	7	25	n. 30 w.	36

Stations.	Component direction from—				Resultant.	
	N.	S.	E.	W.	Direction from—	Duration.
North Dakota—Continued.	*Hours.*	*Hours.*	*Hours.*	*Hours.*	°	*Hours.*
Williston, N. Dak	19	17	11	30	n. 84 w.	19
Upper Mississippi Valley.						
Minneapolis, Minn.*	8	9	4	18	s. 86 w.	14
St. Paul, Minn	18	19	11	31	s. 87 w.	20
La Crosse, Wis.†	8	14	0	11	s. 61 w.	12
Davenport, Iowa	15	14	7	39	n. 88 w.	32
Des Moines, Iowa	20	18	9	29	n. 84 w.	20
Dubuque, Iowa	17	20	6	34	s. 84 w.	28
Keokuk, Iowa	18	19	10	34	s. 88 w.	24
Cairo, Ill	19	25	8	23	s. 68 w.	16
Springfield, Ill	11	25	7	33	s. 62 w.	30
Hannibal, Mo.†	5	10	3	19	s. 73 w.	17
St. Louis, Mo	17	18	12	27	s. 86 w.	15
Missouri Valley.						
Columbia, Mo.*	9	9	6	13	w.	7
Kansas City, Mo	23	22	11	22	n. 85 w.	11
Springfield, Mo	19	22	14	24	s. 73 w.	10
Topeka, Kans.*	12	7	4	12	n. 58 w.	9
Lincoln, Nebr	25	19	8	23	n. 68 w.	16
Omaha, Nebr	25	23	4	22	n. 84 w.	18
Valentine, Nebr	30	7	7	34	n. 50 w.	36
Sioux City, Iowa†	11	13	2	14	s. 81 w.	12
Pierre, S. Dak	24	10	19	21	n. 8 w.	14
Huron, S. Dak	23	18	9	27	n. 74 w.	19
Yankton, S. Dak.†	8	9	4	17	s. 86 w.	13
Northern Slope.						
Havre, Mont	8	17	10	43	s. 75 w.	34
Miles City, Mont	14	22	6	32	s. 73 w.	27
Helena, Mont	17	16	4	38	n. 88 w.	34
Kalispell, Mont	5	13	2	47	s. 80 w.	46
Rapid City, S. Dak	27	6	7	38	n. 56 w.	37
Cheyenne, Wyo	31	7	1	41	n. 59 w.	47
Lander, Wyo	15	27	17	29	s. 14 w.	12
Yellowstone Park, Wyo	6	41	5	22	s. 26 w.	39
North Platte, Nebr	19	9	9	37	n. 70 w.	30
Middle Slope.						
Denver, Colo	15	29	13	18	s. 20 w.	15
Pueblo, Colo	26	11	19	20	n. 4 w.	15
Concordia, Kans	18	25	10	24	s. 63 w.	16
Dodge, Kans	19	15	13	27	n. 74 w.	15
Wichita, Kans	26	21	12	16	n. 39 w.	6
Oklahoma, Okla	25	20	11	18	n. 54 w.	9
Southern Slope.						
Abilene, Tex	21	29	10	15	s. 32 w.	9
Amarillo, Tex	21	19	4	31	n. 86 w.	27
Southern Plateau.						
El Paso, Tex	26	2	15	33	n. 38 w.	29
Santa Fe, N. Mex	26	19	28	7	n. 72 e.	22
Flagstaff, Ariz	27	10	23	15	n. 25 e.	19
Phoenix, Ariz	16	12	27	18	n. 66 e.	10
Yuma, Ariz	50	4	9	6	n. 4 e.	46
Independence, Cal	29	15	6	29	n. 59 w.	27
Middle Plateau.						
Carson City, Nev	15	22	19	17	s. 16 e.	7
Winnemucca, Nev	21	13	26	17	n. 48 e.	12
Modena, Utah	15	4	19	32	n. 50 w.	17
Salt Lake City, Utah	21	20	24	17	n. 82 e.	7
Grand Junction, Colo	20	16	29	16	n. 73 e.	14
Northern Plateau.						
Baker City, Oreg	6	39	25	15	s. 17 e.	34
Boise, Idaho	15	23	11	28	s. 65 w.	19
Lewiston, Idaho†	2	12	13	7	s. 31 e.	12
Pocatello, Idaho	3	19	25	23	s. 7 e.	16
Spokane, Wash	24	21	23	11	n. 76 e.	12
Walla Walla, Wash	12	28	11	23	s. 37 w.	20
North Pacific Coast Region.						
North Head, Wash	13	22	36	6	s. 73 e.	31
Port Crescent, Wash*	1	8	17	9	s. 49 e.	11
Seattle, Wash	17	25	30	8	s. 79 e.	23
Tacoma, Wash	14	30	14	19	s. 17 w.	17
Tatoosh Island, Wash	6	22	34	7	s. 59 e.	31
Portland, Oreg	17	20	25	19	s. 63 e.	7
Roseburg, Oreg	16	19	23	20	s. 45 e.	4
Middle Pacific Coast Region.						
Eureka, Cal	19	24	19	15	s. 39 e.	6
Mount Tamalpais, Cal	34	10	21	15	n. 14 e.	25
Red Bluff, Cal	37	17	12	8	n. 11 e.	20
Sacramento, Cal	24	22	24	7	n. 83 e.	17
San Francisco, Cal	33	9	15	16	n. 2 w.	24
Point Reyes Light, Cal*	17	5	6	8	n. 9 w.	12
Southeast Farallon, Cal*	18	5	5	10	n. 21 w.	14
South Pacific Coast Region.						
Fresno, Cal	28	9	17	23	n. 18 w.	20
Los Angeles, Cal	21	6	21	26	n. 18 w.	16
San Diego, Cal	33	5	19	19	n.	28
San Luis Obispo, Cal	27	15	4	16	n. 45 w.	17
West Indies						
Basseterre, St. Kitts, W. I						
Bridgetown, Barbados						
Cienfuegos, Cuba						
Colon, Colombia, S. A.†						
Curaçoa, W. I						
Grand Turk, W. I.†	11	5	22	1	n. 74 e.	22
Hamilton, Bermuda	23	16	8	26	n. 69 w.	19
Havana, Cuba†	16	3	14	2	n. 43 e.	18
Kingston, Jamaica						
Port of Spain, Trinidad†						
Puerto Principe, Cuba						
Roseau, Dominica, W. I.†						
San Juan, Porto Rico	11	28	35	7	s. 59 e.	33
Santiago de Cuba, Cuba						

* From observations at 8 p. m. only. † From observations at 8 a. m. only.

TABLE IV.—*Thunderstorms and auroras, December, 1903.*

States.	No. of stations.		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Total. No.	Total. Days.	
Alabama	52	T.												1	1												2							4	3	T.
		A.																																0	0	A.
Arizona	56	T.																																0	0	T.
		A.											2																					2	1	A.
Arkansas	57	T.												2							4				2	6								14	4	T.
		A.																																0	0	A.
California	167	T.																		1														1	1	T.
		A.																																0	0	A.
Colorado	81	T.																																0	0	T.
		A.																																0	0	A.
Connecticut	21	T.																													2			2	1	T.
		A.																																0	0	A.
Delaware	5	T.																																0	0	T.
		A.																																0	0	A.
Dist. of Columbia	4	T.																																0	0	T.
		A.																																0	0	A.
Florida	47	T.		7										1												1	1						10	4	T.
		A.																																0	0	A.
Georgia	55	T.																									13							13	1	T.
		A.		1																														1	1	A.
Idaho	34	T.																																0	0	T.
		A.																																0	0	A.
Illinois	92	T.	1											4							2					1								8	4	T.
		A.													1																			1	1	A.
Indiana	58	T.																																0	0	T.
		A.																																0	0	A.
Indian Territory	11	T.												1											1	4								6	3	T.
		A.																																0	0	A.
Iowa	149	T.																																0	0	T.
		A.																																0	0	A.
Kansas	77	T.											1	3										2	10	1								17	5	T.
		A.																																0	0	A.
Kentucky	41	T.																																0	0	T.
		A.																																0	0	A.
Louisiana	46	T.	1										1	7							1	2					7							2	1	T.
		A.																																17	4	A.
Maine	19	T.																																0	0	T.
		A.																																0	0	A.
Maryland	48	T.													4																			4	1	T.
		A.											1							1							1							4	2	A.
Massachusetts	48	T.									2																			1				4	3	T.
		A.													2	1		1													3			5	2	A.
Michigan	106	T.																																4	3	T.
		A.														1																		0	0	A.
Minnesota	67	T.																																1	1	T.
		A.																																0	0	A.
Mississippi	44	T.												8							1						4					1		13	3	T.
		A.																																0	0	A.
Missouri	95	T.											1	9												1								11	3	T.
		A.																																0	0	A.
Montana	40	T.																																0	0	T.
		A.														1																		1	1	A.
Nebraska	142	T.																																0	0	T.
		A.			1																													1	1	A.
Nevada	40	T.																									1			1				3	2	T.
		A.																																0	0	A.
New Hampshire	19	T.																																0	0	T.
		A.																																0	0	A.
New Jersey	51	T.												4		1											1							6	3	T.
		A.									1																							1	1	A.
New Mexico	31	T.																																0	0	T.
		A.																						1										1	1	A.
New York	99	T.																																0	0	T.
		A.												1																	2	1		4	2	A.
North Carolina	56	T.																																0	0	T.
		A.									1																1							2	2	A.
North Dakota	48	T.																																0	0	T.
		A.		1				1							1		1		1			1												6	4	A.
Ohio	128	T.																																0	0	T.
		A.																						1										1	1	A.
Oklahoma	23	T.												1																				0	0	T.
		A.																						3	1									4	2	A.
Oregon	74	T.																			4													4	2	T.
		A.																																0	0	A.
Pennsylvania	91	T.																																0	0	T.
		A.													1																			1	1	A.
Rhode Island	7	T.																													6			6	2	T.
		A.																																0	0	A.
South Carolina	46	T.																									5							5	2	T.
		A.																																0	0	A.
South Dakota	56	T.																																0	0	T.
		A.				1							1	1						1							1					1		6	3	A.
Tennessee	56	T.																			1				1									3	2	T.
		A.											1							1	1			1								1		5	3	A.
Texas	95	T.				2							2													1						1		4	2	T.
		A.																																0	0	A.
Utah	47	T.																						1										1	1	T.
		A.																																0	0	A.
Vermont	16	T.																																0	0	T.
		A.																																0	0	A.
Virginia	50	T.																																0	0	T.
		A.																			1													1	1	A.
Washington	64	T.	1										1																					2	2	T.
		A.																			3													3	2	A.
West Virginia	43	T.																																0	0	T.
		A.																																0	0	A.
Wisconsin	60	T.																																0	0	T.
		A.																																0	0	A.
Wyoming	31	T.																		1														1	1	T.
		A.																																0	0	A.
Sums	2893	T.	3	7	0	2	0	0	0	0	4	0	4	39	1	0	0	0	0	1	17	1	0	0	8	15	24	23	0	0	13	1	1	164	....	T.
		A.	0	2	0	2	0	1	0	0	0	0	3	2	15	3	2	1	1	3	0	3	0	0	1	0	4	0	0	2	0	2	0	47	....	A.

TABLE V.—*Accumulated amounts of precipitation for each 5 minutes, for storms in which the rate of fall equaled or exceeded 0.25 in any 5 minutes, or 0.75 in 1 hour during December, 1903, at all stations furnished with self-registering gages.*

Stations.	Date.	Total duration.		Total amount of precipitation.	Excessive rate.		Amount before excessive began.	Depths of precipitation (in inches) during periods of time indicated.													
		From—	To—		Began—	Ended—		5 min.	10 min.	15 min.	20 min.	25 min.	30 min.	35 min.	40 min.	45 min.	50 min.	60 min.	80 min.	100 min.	120 min.
	1	2	3	4	5	6	7														
Albany, N. Y	9-10			0.70														*			
Alpena, Mich	19-20			0.28														*			
Amarillo, Tex	8			T.																	
Asheville, N. C	12-13			0.16														0.05			
Atlanta, Ga	20			0.44														0.22			
Atlantic City, N. J	13			0.69														0.31			
Augusta, Ga	25			1.15														0.51			
Baltimore, Md	19-20			1.19														0.22			
Binghamton, N. Y	9-10			0.91														*			
Birmingham, Ala	19-20			0.80														0.39			
Bismarck, N. Dak	2-3			0.44														*			
Block Island, R. I	20			0.80														*			
Boise, Idaho	22			0.20														*			
Boston, Mass	9-10			0.75														0.24			
Buffalo, N. Y	12-13			0.66														0.21			
Cairo, Ill	23-24			1.19														0.36			
Charleston, S. C	9			0.63														0.23			
Charlotte, N. C	19-20			0.47														*			
Chattanooga, Tenn	19-20			1.33														0.24			
Chicago, Ill	12			1.23														*			
Cincinnati, Ohio	19-20			0.89														0.11			
Cleveland, Ohio	19-20			0.71														0.12			
Columbia, Mo	12			0.38														*			
Columbia, S. C	25			0.79														0.45			
Columbus, Ohio	19-20			1.06														*			
Concord, N. H	20			1.17														*			
Corpus Christi, Tex	4	6:01 a. m.	7:40 a. m.	0.55	6:10 a. m.	6:27 a. m.	T.	0.06	0.17	0.42	0.50										
Davenport, Iowa	12			0.43														*			
Denver, Colo	23-24			0.14														*			
Des Moines, Iowa	8-9			0.04																	
Detroit, Mich	12-13			0.93														*			
Dodge, Kans																		*			
Dubuque, Iowa	25			0.26														*			
Duluth, Minn	2-2			0.53														*			
Eastport, Me	13			0.66														0.21			
Elkins, W. Va	19-20			0.83														0.14			
Erie, Pa	19-20			0.47														*			
Escanaba, Mich	2-3			0.33														*			
Evansville, Ind	23-24			1.26														*			
Fort Smith, Ark	23-24			1.61														0.29			
Fort Worth, Tex †	24			0.21														0.06			
Galveston, Tex	12			0.90														0.71			
Grand Junction, Colo	18			0.02																	
Grand Rapids, Mich	12-14			0.83														*			
Green Bay, Wis	11-12			0.16														*			
Harrisburg, Pa	19-20			1.09														0.18			
Hatteras, N. C	9			1.20														0.25			
Huron, S. Dak	11-12			0.31														*			
Indianapolis, Ind	12-13			0.31														*			
Jacksonville, Fla	25-26			0.67														0.41			
Jupiter, Fla	2			0.19														0.18			
Kalispell, Mont	13			0.34														*			
Kansas City, Mo	23			0.68														0.19			
Key West, Fla	2			0.42													0.42				
Knoxville, Tenn	19-20			1.03														0.13			
La Crosse, Wis	11-12			0.44														*			
Lewiston, Idaho	15-16			0.40														0.08			
Lexington, Ky	19-20			1.18														*			
Lincoln, Nebr	8-9			0.05														*			
Little Rock, Ark	18-19			1.08														0.15			
Los Angeles, Cal	7			T.																	
Louisville, Ky	24			0.42														0.19			
Lynchburg, Va	19-20			0.96														0.13			
Macon, Ga	25			1.05														0.53			
Memphis, Tenn	18 19			1.95														0.32			
Meridian, Miss	12			0.90														0.35			
Milwaukee, Wis	12			0.77														*			
Montgomery, Ala	25			0.88														0.42			
Nantucket, Mass	9			0.61														0.22			
Nashville, Tenn	19-20			2.59														0.44			
New Haven, Conn	9			0.56														0.23			
New Orleans, La	12	12:15 p. m.	7:00 p. m.	0.90	5:05 p. m.	5:35 p. m.	0.08	0.08	0.14	0.22	0.39	0.57	0.65								
	25	8:25 a. m.	11:35 a. m.	1.77	8:45 a. m.	9:20 a. m.	0.08	0.09	0.11	0.23	0.38	0.50	0.66	0.74							
New York, N. Y	9			0.71														0.20			
Norfolk, Va	20			0.51														0.26			
Northfield, Vt	20-21			1.19														*			
North Head, Wash	10			0.76														0.36			
Oklahoma, Okla	23			0.60							0.31										
Omaha, Nebr	8-9			0.12														0.02			
Palestine, Tex	11-12			0.86														0.21			
Parkersburg, W. Va	19-20			0.85														0.13			
Pensacola, Fla	25			0.96														0.65			
Philadelphia, Pa	13			0.65														0.25			
Pittsburg, Pa	19-20			0.72														*			
Pocatello, Idaho	11			0.34														*			
Portland, Me	9-10			1.90														0.54			
Portland, Oreg	15-16			0.86														0.18			
Pueblo, Colo	19			0.03														*			
Raleigh, N. C	19-20			0.98																	
Richmond, Va	19-20			1.21														0.20			
Rochester, N. Y	19-20			0.46														*			
Sacramento, Cal	16			0.69														0.20			
St. Louis, Mo	12			0.60														0.16			
St. Paul, Minn	2-3			0.19														0.07			
Salt Lake City, Utah	18			0.22														*			
San Antonio, Tex	12			0.65														0.32			
San Diego, Cal	7			0.33														*			
Sandusky, Ohio	19-20			0.65														*			
San Francisco, Cal	15-16			1.06														0.47			
Savannah, Ga	9			0.50														0.16			
Scranton, Pa	13			0.63														0.14			

TABLE V.—*Accumulated amounts of precipitation for each 5 minutes, etc.*—Continued.

Stations.	Date.	Total duration. From—	Total duration. To—	Total amount of precipitation.	Excessive rate. Began—	Excessive rate. Ended—	Amount before excessive began.	Depths of precipitation (in inches) during periods of time indicated. 5 min.	10 min.	15 min.	20 min.	25 min.	30 min.	35 min.	40 min.	45 min.	50 min.	60 min.	80 min.	100 min.	120 min.
1	1	2	3	4	5	6	7														
Seattle, Wash	14-16			2.11														0.22			
Shreveport, La	12			1.86														0.63			
Spokane, Wash	19			0.51														*			
Springfield, Ill	12			0.81														*			
Syracuse, N. Y	9-10			0.62														*			
Tampa, Fla	3			0.57														0.46			
Taylor, Tex	11 12			0.93														0.58			
Toledo, Ohio	12-13			0.85														*			
Topeka, Kans	23			0.40														*			
Valentine, Nebr	25			0.05														*			
Vicksburg, Miss	9			0.83														0.46			
Washington, D. C	19-20			1.19														0.22			
Wichita, Kans	23			0.25														*			
Wilmington, N. C	25			0.98														0.49			
Wytheville, Va	19-20			0.83														*			
Yankton, S. Dak	11			0.15														*			
Havana, Cuba	28 29			1.38														0.40			
San Juan, Porto Rico	7	7:10 p.m.	11:00 p.m.	1.10	9:45 p.m.	10:15 p.m.	0.26	0.08	0.27	0.43	0.59	0.70	0.75								
					10:00 p.m.	10:55 p.m.	0.23	0.11	0.18	0.21	0.25	0.33	0.41	0.57	0.72	0.87	0.96	1.05			
Do	18 19	8:10 p.m.	5:00 a.m.	3.97	12:20 a.m.	12:50 a.m.	1.44	0.21	0.30	0.39	0.47	0.55	0.61	0.67							
					3:10 a.m.	4:00 a.m.	2.89	0.08	0.21	0.30	0.37	0.50	0.67	0.77	0.85	0.96	1.01				

*Self register not working. † No precipitation during the month.

TABLE VI.—*Data furnished by the Canadian Meteorological Service, December, 1903.*

Stations.	Pressure, in inches. Actual, reduced to mean of 24 hours.	Pressure, in inches. Sea level, reduced to mean of 24 hours.	Pressure, in inches. Departure from normal.	Temperature. Mean.	Temperature. Departure from normal.	Temperature. Mean maximum.	Temperature. Mean minimum.	Precipitation. Total.	Precipitation. Departure from normal.	Precipitation. Depth of snow.
	Ins.	*Ins.*	*Ins.*	°	°	°	°	*Ins.*	*Ins.*	*Ins.*
St. Johns, N. F	29.57	29.71	—.12	31.3	+ 2.6	37.6	25.1	6.21	+1.18	26.0
Sydney, C. B. I	29.79	29.83	—.06	28.0	— 0.2	34.8	21.2	6.08	+1.45	19.0
Halifax, N. S	29.76	29.87	—.09	28.2	+ 0.6	35.6	20.7	4.58	−0.54	13.8
Grand Manan, N. B	29.81	29.86	—.12	25.3	— 3.0	32.1	18.5	2.56	−1.86	3.5
Yarmouth, N. S	29.82	29.89	—.09	30.0	— 0.7	35.6	24.4	6.22	+1.18	28.3
Charlottetown, P. E. I	29.80	29.84	—.10	22.4	— 1.9	29.5	15.4	4.32	+0.66	24.4
Chatham, N. B	29.80	29.83	—.11	15.2	— 1.8	24.2	6.2	2.92	−0.30	20.4
Father Point, Que	29.81	29.84	—.11	12.1	— 3.3	19.8	4.5	3.46	+0.63	28.6
Quebec, Que	29.90	29.90	—.11	10.9	— 4.3	18.1	3.7	3.20	−0.49	22.6
Montreal, Que	29.72	29.95	—.08	14.2	— 4.1	21.6	6.8	4.33	+0.68	38.5
Bissett, Ont	29.32	29.97	—.04	2.7	−12.3	16.3	−10.9	2.91	+0.42	29.1
Ottawa, Ont	29.58	29.92	—.10	11.5	— 5.5	19.9	3.1	1.98	−0.93	19.8
Kingston, Ont	29.62	29.96	—.08	19.1	— 4.6	27.3	10.8	3.02	−0.22	19.4
Toronto, Ont	29.57	29.97	—.08	22.9	— 4.1	29.6	16.1	1.99	−0.92	9.5
White River, Ont	28.53	29.92	—.05	0.8	— 8.9	15.5	−13.9	1.68	−0.03	16.8
Port Stanley, Ont	29.33	30.00	—.07	25.2	— 5.2	28.9	17.4	3.88	+1.46	20.6
Saugeen, Ont	29.29	29.93	—.09	22.6	— 4.1	30.6	14.5	7.07	+3.09	69.8
Parry Sound, Ont	29.16	29.90	—.11	14.7	— 6.5	25.2	4.1	2.99	−1.49	29.9
Port Arthur, Ont	29.22	29.96	—.03	7.5	— 5.7	16.5	— 1.5	0.18	−0.69	1.8
Winnipeg, Man	29.14	30.03	+.01	2.2	— 1.9	13.2	— 8.8	1.02	+0.11	10.2
Minnedosa, Man	28.12	30.03	+.01	8.2	+ 2.5	19.4	— 3.1	0.77	+0.15	7.7
Qu'Appelle, Assin	27.66	30.02	+.02	11.6	+ 4.2	21.3	2.0	0.96	+0.44	9.6
Medicine Hat, Assin	27.71	30.04	+.07	29.7	+11.5	39.6	19.8	0.12	−0.43	1.0
Swift Current, Assin	27.41	30.09	+.10	21.5	+ 5.5	29.9	13.0	0.61	−0.62	6.1
Calgary, Alberta	26.40	30.05	+.11	26.2	+ 8.0	36.6	15.9	0.25	−0.34	1.5
Banff, Alberta	25.40	30.16	+.22	24.3	+ 5.2	31.0	17.5	0.64	−0.57	2.4
Edmonton, Alberta	27.63	29.99	+.06	25.0	+11.9	32.1	17.9	0.61	−0.09	5.7
Prince Albert, Sask	28.38	30.01	.00	8.9	+ 6.1	18.1	— 0.4	0.40	−0.34	4.0
Battleford, Sask	28.26	30.09	+.10	13.2	+ 7.8	21.5	5.0	0.57	+0.25	3.7
Kamloops, B. C	28.93	30.18	+.24	32.2	+ 3.3	36.7	27.7	0.54	−0.24	2.4
Victoria, B. C	30.03	30.13	+.16	43.0	+ 1.8	45.9	40.1	2.41	−5.57	0.0
Barkerville, B. C	25.70	30.10	+.22	25.5	+ 4.6	30.6	20.3	2.20	−0.97	22.0
Hamilton, Bermuda	29.91	30.08	—.04	64.4	— 0.3	69.1	59.6	10.58	+6.09	

TABLE VII.—*Heights of rivers referred to zeros of gages, December, 1903.*

Stations.	Distance to mouth of river.	Danger line on gage.	Highest water. Height.	Highest water. Date.	Lowest water. Height.	Lowest water. Date.	Mean stage.	Monthly range.
Mississippi River.	*Miles.*	*Feet.*	*Feet.*		*Feet.*		*Feet.*	*Feet.*
St. Paul, Minn [1]	1,954	14	5.6	3, 4	4.8	9	.....	0.8
Red Wing, Minn [1]	1,914	14	3.3	1	3.0	9	.....	0.3
Reeds Landing, Minn [2]	1,884	12	2.3	1, 2	1.3	§16–18, 28–31	1.6	1.0
La Crosse, Wis [3]	1,819	12	.....	.....	.....	.....	.....	.....
Prairie du Chien, Wis [4]	1,759	18	.....	.....	.....	.....	.....	.....
Dubuque, Iowa [5]	1,699	15	6.7	10	3.2	1	.....	3.5
Leclaire, Iowa [4]	1,609	10	.....	.....	.....	.....	.....	.....
Davenport, Iowa [6]	1,593	15	6.5	16	2.0	2	3.0	4.5
Muscatine, Iowa	1,562	16	7.3	19	3.4	3–6	5.4	4.1
Galland, Iowa [7]	1,472	8	1.6	1,2,6,8-11	1.0	13	.....	0.6
Keokuk, Iowa [7]	1,463	15	3.6	13	1.1	7	.....	2.5
Hannibal, Mo	1,402	13	4.3	28, 30, 31	0.5	14, 15	2.8	3.8
Grafton, Ill	1,306	23	6.0	1	2.5	16	4.2	3.5
St. Louis, Mo	1,264	30	6.1	1	0.5	17	3.5	5.6
Chester, Ill	1,189	30	5.9	1	1.4	18	3.9	4.5
New Madrid, Mo	1,003	34	9.5	2	2.8	21	6.4	6.7
Memphis, Tenn	843	33	6.0	4	1.0	22, 23	3.5	5.0
Helena, Ark	767	42	9.2	5	2.8	23	6.1	6.4
Arkansas City, Ark	635	42	10.0	1	2.2	25	6.3	7.8
Greenville, Miss	593	42	8.1	1	2.7	25, 26	5.4	5.4
Vicksburg, Miss	474	45	7.8	1	0.2	27, 28	4.2	7.6
Natchez, Miss	373	46	10.1	1	4.2	28	7.4	5.9
Baton Rouge, La	240	35	5.6	3, 4	2.0	28	4.1	3.6
Donaldsonville, La	188	28	3.9	4	1.5	27, 30	3.0	2.4
New Orleans, La	108	16	4.7	2	3.4	9	4.1	1.3
James River.								
Huron, S. Dak [4]	98	17	.....	.....	.....	.....	.....	.....
Missouri River.	*Miles.*	*Feet.*	*Feet.*		*Feet.*		*Feet.*	*Feet.*
Bismarck, N. Dak	1,309	25	2.5	16	0.2	28	1.4	2.3
Pierre, S. Dak [4]	1,114	9	.....	.....	.....	.....	.....	.....
Sioux City, Iowa [4]	784	10	.....	.....	.....	.....	.....	.....
Omaha, Nebr [8]	669	12	7.2	22	4.1	5	5.7	3.1
St. Joseph, Mo	481	14	0.6	2	−3.2	16	−1.2	3.8
Kansas City, Mo	388	14	7.2	29	3.5	16	5.6	3.7
Boonville, Mo	199	19	6.2	26	3.3	19	5.0	2.9
Hermann, Mo	103	18	5.5	§1, 5, 6, 30, 31	2.6	16	4.6	2.9
Illinois River.								
Peoria, Ill	135	14	10.1	30, 31	8.5	7-9	9.0	1.6
Youghiogheny River.								
Confluence, Pa	59	10	2.6	26	0.0	5-20	0.4	2.6
West Newton, Pa [9]	15	23	5.5	26	0.3	1-4	.....	5.2
Allegheny River.								
Warren, Pa	177	14	1.7	1	1.0	13-21	1.3	0.7
Oil City, Pa	123	13	3.8	22	1.3	14	2.2	2.5
Parker, Pa	73	20	2.8	23-26	1.4	18, 19	2.0	1.4
Freeport, Pa [10]	29	20	8.8	29	3.0	15	5.0	5.8
Clarion River.								
Clarion, Pa	32	10	3.3	23	1.0	3, 12	2.4	2.3
Monongahela River.								
Weston, W. Va	161	18	1.0	26, 27	−1.3	7-9	−0.7	2.3
Fairmont, W. Va	119	25	17.4	26	4.8	8	11.5	12.6
Greensboro, Pa [11]	81	18	11.0	26	6.1	13, 14	7.1	4.9
Lock No. 4, Pa	40	28	10.6	27	6 0	17	7.5	4.6
Conemaugh River.								
Johnstown, Pa	64	7	3.3	25	0.7	20	1.5	2.6

TABLE VII.—*Heights of rivers referred to zeros of gages*—Continued.

Stations.	Distance to mouth of river.	Danger line on gage.	Highest water.		Lowest water.		Mean stage.	Monthly range.
			Height.	Date.	Height.	Date.		
Red Bank Creek.	*Miles.*	*Feet.*	*Feet.*		*Feet.*		*Feet.*	*Feet.*
Brookville, Pa.	35	8	0.2	1-31	6.2	1-31	0.2	0.0
Beaver River.								
Ellwood Junction, Pa.	10	14	.....	.....	.....	.....	.....	.....
Great Kanawha, River.								
Charleston, W. Va.	58	30	6.8	7-10	0.1	19	3.3	6.7
Little Kanawha River.								
Glenville, W. Va.	103	20	2.5	26	—1.4	1, 13	0.3	3.9
New River.								
Radford, Va.	155	14	2.0	22	—0.2	19-21	0.3	2.2
Hinton, W. Va.	95	14	1.7	25	1.2	1-4, 14-20	1.3	0.5
Cheat River.								
Rowlesburg, W. Va.[3]	36	14	.....	.....	.....	.....	.....	.....
Ohio River.								
Pittsburg, Pa.	966	22	6.4	27	1.6	5	4.3	4.8
Davis Island Dam, Pa.	960	25	8.4	27	3.0	16	4.6	.45
Beaver Dam, Pa	925	27	10.5	27	3.5	6	6.0	7.0
Wheeling, W. Va.	875	36	9.9	28	3.0	14	5.2	6.9
Parkersburg, W. Va.	785	36	9.4	27	3.2	18, 20	5.4	6.2
Point Pleasant, W. Va.	705	39	9.1	26	1.9	18-20	4.1	7.2
Huntington, W. Va.	660	50	12.5	26	4.3	17	7.2	8.2
Catlettsburg, Ky.	651	50	11.2	28	2.3	15	5.5	8.9
Portsmouth, Ohio	612	50	12.8	27	3.3	17	6.5	9.5
Cincinnati, Ohio.	499	50	22.8	29	5.8	12, 13	9.6	17.0
Madison, Ind	413	46	13.0	30	5.3	11	7.5	7.7
Louisville, Ky.	367	28	7.2	31	2.8	20	4.2	4.4
Evansville, Ind.	184	35	8.5	1	3.3	15, 17-20	5.2	5.2
Paducah, Ky.	47	40	7.7	29	1.6	18, 19	4.3	6.1
Cairo, Ill.	1,073	45	11.9	1	2.9	20	7.9	9.0
Muskingum River.								
Zanesville, Ohio	70	20	10.3	21	7.3	13-19	8.0	3.0
Scioto River.								
Columbus, Ohio[12]	110	17	.....	.....	.....	.....	.....	.....
Miami River.								
Dayton, Ohio[13]	77	18	3.0	21	0.5	13	1.2	2.5
Wabash River.								
Mount Carmel, Ill.[8]	50	15	3.5	25	0.8	1, 2, 11, 12	1.6	2.7
Licking River.								
Falmouth, Ky.[14]	30	25	.....	.....	.....	.....	.....	.....
Kentucky River.								
High Bridge, Ky.	117	17	12.0	27	8.4	2	9.7	3.6
Frankfort, Ky.	65	31	8.2	27, 28	5.8	8-13, 15-19	6.4	2.4
Clinch River.								
Speers Ferry, Va.	156	20	1.7	26	—1.0	7, 8, 14, 15	—0.2	2.7
Clinton, Tenn.	52	25	8.8	28	2.5	{1, 2, 5, 6, 8, 9, 16, 17}	4.1	6.3
Holston River.								
Bluff City, Tenn.	170	15	1.5	21, 26, 27	—0.2	1, 7, 12, 19	0.4	1.7
Rogersville, Tenn.	103	14	2.7	27	1.2	10, 11, 19	1.6	1.5
French Broad River.								
Asheville, N. C.	144	14	0.0	21	—0.7	1-19, 25	—0.6	0.7
Leadvale, Tenn.	70	15	0.4	27	—1.7	10	—0.8	2.1
Hiwassee River.								
Charleston, Tenn	18	22	1.8	21	0.4	{1, 4, 7, 8, 11, 12, 19}	0.7	1.4
Tennessee River.								
Knoxville, Tenn.	635	29	1.5	29	0.1	4-12, 14, 15	0.5	1.4
Kingston, Tenn.	556	25	3.8	21	0.8	1-9, 17-19	1.5	3.0
Chattanooga, Tenn.	452	33	4.7	22	0.9	{6, 8, 10-12, 14, 15}	2.0	3.8
Bridgeport, Ala.	402	24	3.2	23	0.1	8-12	1.0	3.1
Florence, Ala.	255	16	3.0	25	—0.3	9-13	0.7	3.3
Riverton, Ala.	225	25	3.4	25	—1.5	10, 11, 18	0.1	4.9
Johnsonville, Tenn.	95	24	5.5	23	0.4	10-19	1.9	5.1
Cumberland River.								
Burnside, Ky.	516	50	17.3	21	1.3	17-19	4.5	16.0
Celina, Tenn.	383	45	15.5	23	1.0	5-19	5.2	14.5
Carthage, Tenn.	305	40	13.4	23	0.6	19	4.6	12.8
Nashville, Tenn.	189	40	16.8	21	1.4	12-19	6.7	15.4
Clarksville, Tenn.	126	42	19.4	22	1.8	18, 19	8.0	17.6
Arkansas River.								
Wichita, Kans.	832	10	0.7	20	0.1	27	0.3	0.6
Webbers Falls, Ind. T.	465	23	3.0	1, 2	2.3	20-23	2.6	0.7
Fort Smith, Ark.	403	22	3.5	26	2.3	5-24	2.5	1.2
Dardanelle, Ark.	256	21	4.2	26	1.7	11, 12	2.3	2.5
Little Rock, Ark.	176	23	5.4	28	3.1	12, 22-24	3.6	2.3
White River.								
Newport, Ark.	150	26	3.7	31	0.5	12-15	1.2	3.2
Yazoo River.								
Yazoo City, Miss.	80	25	2.5	30, 31	—2.4	12	—1.1	4.9
Red River.								
Arthur City, Tex.	638	27	4.8	4, 5	4.2	8-26	4.3	0.6
Fulton, Ark.	515	28	8.0	28	3.9	5, 6, 11, 12	5.1	4.1
Shreveport, La.	327	29	—0.4	31	—2.1	7	—1.8	1.7
Alexandria, La.	118	33	—0.1	31	—1.1	24	—0.8	1.0
Ouachita River.								
Camden, Ark.	304	39	10.1	28	3.6	8-14	5.1	6.5
Monroe, La.	122	40	5.1	31	1.4	1-13	2.4	3.7
Atchafalaya River.								
Melville, La.	100	31	8.3	1	3.9	29	6.3	4.4
Penobscot River.								
Mattawamkeag, Me.[4]	87	.....	.....	.....	.....	.....	.....	.....
Montague, Me.[15]	60	.....	2.4	14	1.6	3, 4, 7-10	.....	0.8
Kennebec River.								
Winslow, Me	46	.....	4.7	23	—0.9	20	2.8	5.6
Merrimac River.								
Franklin Junction, N. H.	110	.....	6.4	22	3.8	1, 6, 7	4.4	2.6
Concord, N. H.[4]	94	.....	.....	.....	.....	.....	.....	.....
Manchester, N. H.	68	.....	4.2	25	0.9	2	3.0	3.3
Connecticut River.								
Wells River, Vt.[4]	255	.....	.....	.....	.....	.....	.....	.....
White River Junction, Vt[16]	209	.....	8.5	22	4.3	6	5.9	4.2
Bellows Falls, Vt	170	12	3.3	22	—0.5	5	1.4	3.8
Holyoke, Mass.	84	9	3.9	21	—0.8	12	1.9	4.7
Hartford, Conn.	50	13	9.3	22	1.8	7	4.4	7.5

Stations.	Distance to mouth of river.	Danger line on gage.	Highest water.		Lowest water.		Mean stage.	Monthly range.
			Height.	Date.	Height.	Date.		
Housatonic River.	*Miles.*	*Feet.*	*Feet.*		*Feet.*		*Feet.*	*Feet.*
Gaylordsville, Conn	50	15	8.2	21	4.1	1	5.0	4.1
Mohawk River.								
Utica, N. Y.[17]	98	.....	3.7	22	0.2	28	1.4	3.5
Schenectady, N. Y.	19	.....	4.2	24	1.3	1-22	1.8	2.9
Hudson River.								
Glens Falls, N. Y.[10]	197	.....	1.3	25, 26	—1.1	11	0.5	2.4
Mechanicsville, N. Y.	166	.....	2.7	21	0.8	28-30	1.6	1.9
Troy, N. Y.[18]	154	.....	4.5	22	0.0	3	1.4	4.5
Albany, N. Y.	147	.....	5.5	22	1.2	14	2.9	4.3
Stuyvesant, N. Y.	128	.....	4.7	9	—0.3	15	1.6	5.0
Passaic River.								
Chatham, N. J.[2]	69	.....	5.2	22	2.3	9	3.5	2.9
Pompton River.								
Pompton Plains, N. J.[9]	6	.....	.....	.....	.....	.....	.....	.....
Susquehanna River.								
Binghamton, N. Y.	306	16	5.1	22	2.0	10	3.0	3.1
Towanda, Pa.	262	16	5.3	23	1.3	12, 14-20	2.3	4.0
Wilkesbarre, Pa	183	17	10.4	28	4.0	12	6.6	6.4
Selinsgrove, Pa	116	17	3.7	23	0.7	18, 19	1.6	3.0
Harrisburg, Pa	69	17	5.7	22	1.0	15-17	2.6	4.7
West Branch Susquehanna.								
Lockhaven, Pa.[4]	65	12	.....	.....	.....	.....	.....	.....
Williamsport, Pa.	39	20	2.4	29, 31	1.0	16-20	1.7	1.4
Juniata River.								
Huntingdon, Pa.[20]	90	24	3.8	26	3.2	9-14	.....	0.6
Shenandoah River.								
Riverton, Va	58	22	—0.4	24-31	—0.5	1-23	—0.5	0.1
Potomac River.								
Cumberland, Md.	290	8	1.7	25, 26	1.4	3-5, 11-19	1.5	0.3
Harpers Ferry, W. Va.	172	18	0.0	7	—0.5	22-26	—0.3	0.5
James River.								
Lynchburg, Va	260	18	0.4	21-23	0.3	1-20, 24-31	0.3	0.1
Richmond, Va.	111	12	0.3	26	—0.5	13	—0.1	0.8
Dan River.								
Danville, Va	55	8	0.4	23	—0.4	19, 20	—0.1	0.8
Roanoke River.								
Clarksville, Va	196	12	4.5	13	3.3	1-5, 17-19	3.5	1.2
Weldon, N. C.	129	30	11.7	22	8.9	1, 2, 20	9.5	2.8
Cape Fear River.								
Fayetteville, N. C.	112	38	9.4	22	2.0	2, 4	3.7	7.4
Edisto River.								
Edisto, S. C.	75	6	.....	.....	.....	.....	.....	.....
Pedee River.								
Cheraw, S. C.	149	27	3.5	23	1.6	4-7	2.1	1.9
Black River.								
Kingstree, S. C.	52	12	6.0	31	4.0	16-20	4.5	2.0
Lynch Creek.								
Effingham, S. C.	35	12	5.0	26	3.5	1, 9-11	4.2	1.5
Santee River.								
St. Stephens, S. C.	97	12	4.1	30	1.7	2-12	2.2	2.4
Congaree River.								
Columbia, S. C.	37	15	0.4	26	—0.3	20	—0.1	0.7
Wateree River.								
Camden, S. C.	45	24	7.5	27	6.0	1-8, 22-24	6.3	1.5
Waccamaw River.								
Conway, S. C.	40	7	2.2	29	0.6	22	1.4	1.6
Savannah River.								
Calhoun Falls, S. C.	347	15	2.4	21	2.0	1	2.2	0.4
Augusta, Ga.	268	32	8.2	28	6.8	5, 6	7.3	1.4
Broad River.								
Carlton, Ga.	30	11	2.7	26	2.1	19	2.3	0.6
Flint River.								
Albany, Ga.	80	20	7.0	31	2.4	18	3.7	4.6
Chattahoochee River.								
Oakdale, Ga.	305	18	1.7	26, 27	1.0	1-9, 12	1.3	0.7
Westpoint, Ga	239	20	3.0	26, 27	2.2	1-5	2.4	0.8
Eufaula, Ala.	90	40	7.5	26	1.7	3-5	3.1	5.8
Ocmulgee River.								
Macon, Ga.	125	18	3.7	26	2.3	3, 4	2.9	1.4
Abbeville, Ga.	50	11	7.0	29	2.9	5-8	3.9	4.1
Oconee River.								
Dublin, Ga	79	20	3.7	27	0.6	3	1.5	3.1
Coosa River.								
Rome, Ga.	271	30	1.3	22, 23	0.6	12-20	0.8	0.7
Gadsden, Ga.	144	22	0.9	24	—0.3	16-20	—0.1	1.2
Alabama River.								
Montgomery, Ala.	265	35	2.6	27	0.4	2-6	1.0	2.2
Selma, Ala	212	35	3.1	29	0.3	6	1.0	2.8
Tombigbee River.								
Columbus, Miss	303	33	—1.6	29, 30	—3.0	{1, 5-11, 17, 18}	—2.6	1.4
Demopolis, Ala.	155	35	3.2	26	—2.0	5, 6	—0.6	5.2
Black Warrior River.								
Tuscaloosa, Ala.	90	43	5.6	25	4.7	1-3	4.9	0.9
Sabine River.								
Logansport, La.	180	25	4.4	16	3.0	11, 21-24	3.6	1.4
Orange, Tex.	10	7	1.4	29-31	0.6	1-4	0.9	0.8
Neches River.								
Rockland, Tex	110	20	2.6	30, 31	0.2	1-3	1.4	2.4
Beaumont, Tex.	40	10	1.6	4	—0.4	15	0.4	2.0
Trinity River.								
Dallas, Tex.	330	25	2.4	19, 25, 26	1.8	13-17	2.1	0.6
Riverside, Tex.	100	40	7.1	14	0.6	1-11	2.6	6.5
Liberty, Tex	42	25	9.1	18	3.6	11	5.5	5.5
Brazos River.								
Kopperl, Tex	369	21	0.0	1-4, 10-14	—0.4	22-31	—0.2	0.4
Waco, Tex.	301	22	2.6	1-6	2.3	{15-25, 27-31}	2.4	0.3
Hempstead, Tex	215	40	3.0	13	—0.8	7-12	0.5	3.8
Booth, Tex	76	39	2.9	20	1.5	18	2.2	1.4
Colorado River.								
Ballinger, Tex.	400	21	1.3	3	1.0	7-15, 19-31	1.1	0.3
Austin, Tex.	214	18	1.3	12	1.2	1-11, 13-31	1.2	0.1
Columbus, Tex.	100	24	9.5	12	5.4	5, 6	6.3	4.1

TABLE VII.—*Heights of rivers referred to zeros of gages.*—Continued.

Stations.	Distance to mouth of river.	Danger line on gage.	Highest water.		Lowest water.		Mean stage.	Monthly range.
			Height.	Date.	Height.	Date.		
Red River of the North.	*Miles.*	*Feet.*	*Feet.*		*Feet.*		*Feet.*	*Feet.*
Moorhead, Minn [4]	418	26	.....	.....	.....	.....	.....	.....
Columbia River.								
Umatilla, Oreg.	270	25	5.7	3, 4 [7]	2.9	31	4.5	2.8
The Dalles, Oreg.	166	40	7.4		4.4	30	6.3	3.0
Willamette River.								
Albany, Oreg	118	20	6.2	1	3.6	11, 12	4.8	2.6
Portland, Oreg.	12	15	8.3	22	3.4	30	5.6	4.9
Sacramento River.								
Red Bluff, Cal.	265	23	14.4	17	2.8	8, 9	5.4	11.6
Sacramento, Cal.	64	29	19.6	1, 2	14.3	16	17.1	5.3

[1] Frozen for 22 days. [2] Frozen for 2 days. [3] Frozen for 27 days. [4] Frozen for 31 days. [5] Frozen for 16 days. [6] Frozen for 15 days. [7] Frozen for 18 days. [8] Frozen for 6 days. [9] Frozen for 19 days. [10] Frozen for 30 days. [11] Frozen for 3 days. [12] Frozen for 26 days. [13] Frozen for 12 days. [14] Frozen for 25 days. [15] Frozen for 17 days. [16] Frozen for 9 days. [17] Frozen for 28 days. [18] Frozen for 26 days. [19] Gage broken.

HAWAIIAN CLIMATOLOGICAL DATA.

By R. C. LYDECKER, Territorial Meteorologist.

Rainfall data for December, 1903.

Stations.	Elevation.	Amount.
HAWAII.		
HILO, e. and ne.	*Feet.*	*Inches.*
Waiakea	50	6.10
Hilo (town)	100	6.03
Puueo	85	6.42
Kaumana	.....	.....
Pepeekeo	100	3.25
Hakalau	200	4.69
Honohina	300	5.74
Puuohua	1,050	8.16
Laupahoehoe	500	6.85
Ookala	.....	.....
HAMAKUA, ne.		
Kukaiau	.....	.....
Paauilo	300	2.27
Paauhau	300	1.72
Honokaa (Mill)	425	2.04
Honokaa (Meinicke)	.....	.....
Kukuihaele	700	2.49
KOHALA, n.		
Awini Ranch	1,100	3.63
Niulii	200	1.87
Kohala (Mission)	521	2.20
Kohala (Sugar Co.)	270	2.16
Hawi, Mill	700	1.95
Puakea Ranch	600	1.71
Puuhue Ranch	1,847	1.50
Waimea	2,720	0.55
KONA, w.		
Huehue	2,000	1.16
Holualoa	1,350	2.30
Kaukahoku Leheula	.....	.....
Kainaliu	.....	.....
Kealakekua	1,580	2.69
Napoopoo	.....	.....
Hoopuloa	1,650	0.99
Hoopuloa	2,300	2.73
Puuwaawaa Ranch	2,700	1.44
Huehue	.....	.....
KAU, se.		
Kahuku Ranch	1,680	1.63
Honuapo	15	1.25
Naalehu	650	1.66
Hilea	310	2.20
Pahala	.....	.....
Moaula	.....	.....
Volcano House	4,000	2.30
PUNA, e.		
Olaa, Mountain View (Russel)	.....	.....
Olaa (Plantation)	210	10.56
Kapoho	.....	.....
Pahoa	.....	.....
MAUI.		
Lahaina	.....	.....
Waiopae Ranch	700	0.00
Kaupo (Mokulau), s.	285	4.29
Kipahulu, s	308	5.30
Hana	.....	.....
Nahiku, ne	.....	.....
Nahiku	850	10.16
Haiku, n	700	5.86
Kula (Waiakoa), n	2,700	0.47
Kula (Erehwon), n	.....	.....
Puuomalei, n	.....	.....
Paia	.....	.....
Haleakala Ranch	2,000	4.88
MAUI—Cont'd.	*Feet.*	*Inches.*
Wailuku, ne	250	1.48
LANAI.		
Keomuku	10	0.00
OAHU.		
Punahou (W. R.), sw.	47	1.44
Kulaokahua (Castle), sw.	50	0.68
Makiki Reservoir	120	1.29
U. S. Naval Station, sw.	6	0.56
Kapiolani Park, sw.	10	0.68
College Hills	175	1.89
Manoa (Woodlawn Dairy), e.	285	5.26
Manoa (Rhodes Gardens)	360	6.42
Insane Asylum	30	1.03
School street (Bishop), sw.	.....	.....
Kamehameha School	.....	.....
Kalihi-Uka, sw	.....	.....
Nuuanu (W. W. Hall), sw.	50	1.13
Nuuanu (Wyllie street)	250	1.78
Nuuanu (Elec. Station), sw.	405	2.70
Nuuanu (Luakaha), e.	850	8.81
U. S. Experiment Station	.....	.....
Kaliiula	.....	.....
Laniakea (Nahuina)	.....	.....
Tantalus Heights (Frear)	1,360	4.99
Waimanalo, ne	25	1.99
Maunawili, ne	300	4.81
Kaneohe	100	4.00
Ahuimanu, ne	.....	.....
Kahuku, n	25	2.67
Waialua	.....	.....
Wahiawa	900	1.79
Ewa Plantation, s.	60	0.18
U. S. Magnetic Station	45	0.01
Waipahu	200	0.00
Moanalua	15	0.45
Pacific Heights	.....	.....
KAUAI.		
Lihue (Grove Farm), e.	200	3.01
Lihue (Molokoa), e.	300	2.56
Lihue (Kukaua), e.	1,000	5.52
Kealia, e.	15	1.53
Kilauea (Plantation), ne.	325	9.50
Hanalei, n	10	7.76
Waioli	.....	.....
Haena	.....	.....
Waiawa	32	0.78
Eleele	150	0.28
Wahiawa (Mountain)	3,000	6.50
McBryde (Residence)	850	2.99
Lawai (Gov. Road)	450	2.96
Lawai, w	225	1.23
Lawai, e	800	2.70
Koloa	50	1.74
Delayed November reports.		
U. S. Experimental Station	.....	5.33
U. S. Magnetic Station	.....	0.81
Wahiawa	.....	1.88
West Lawai	.....	0.36
Waiopae Ranch	.....	0.00
Puuomalei	.....	7.06
Kealia	.....	0.82
Hoopuloa	2,300	3.74
Hoopuloa	1,650	1.75

NOTE.—The letters n, s, e, w, and c show the exposure of the station relative to the winds.

GENERAL SUMMARY FOR DECEMBER, 1903.

Honolulu.—The principal features of the month were the light rainfall, which, with but very few exceptions, on the islands of Maui and Kauai, was considerably below the December normals of the different stations throughout the group,

Meteorological Observations at Honolulu, December, 1903.

The station is at 21° 18′ N., 157° 50′ W. It is the Hawaiian Weather Bureau station Punahou. (See fig. 2, No. 1, in the MONTHLY WEATHER REVIEW for July, 1902, page 365.)

Hawaiian standard time is 10h 30m slow of Greenwich time. Honolulu local mean time is 10h 31m slow of Greenwich.

The pressure is corrected for temperature and reduced to sea level, and the gravity correction, —0.06, has been applied.

The average direction and force of the wind and the average cloudiness for the whole day are given unless they have varied more than usual, in which case the extremes are given. The scale of wind force is 0 to 12, or Beaufort scale. Two directions of wind, or values of wind force, or amounts of cloudiness, connected by a dash, indicate change from one to the other.

Rainfall for twenty-four hours is measured at 9 a. m. local, or 7:31 p. m., Greenwich time.

The rain gage, 8 inches in diameter, is 1 foot above ground. Thermometer, 9 feet above ground. Ground is 43 feet and the barometer 50 feet above sea level.

Date.	Pressure at sea level.	Temperature.		During twenty-four hours preceding 1 p. m. Greenwich time, or 2:30 a. m. Honolulu time.								Total rainfall at 9 a. m., local time.
				Temperature.		Means.		Wind.			Sea-level pressures.	
		Dry bulb.	Wet bulb.	Maximum.	Minimum.	Dew-point.	Relative humidity.	Prevailing direction.	Force.	Average cloudiness.	Maximum.	Minimum.	
	*	†	†			‡	‡		§				
1	30.00	66	65	77	68	66.0	81	ne.	2	0	7-4	30.04	29.97	0.05
2	30.00	67	65.5	78	66	64.7	78	ne.	1-0		2	30.03	29.93	0.05
3	29.96	74	67	79	66	64.7	76	ne.	1	0	1	29.98	29.90	0.17
4	30.00	72	66	79	71	62.7	67	ne.	4		3	30.04	29.97	0.19
5	30.02	73	66	77	72	62.7	70	ne.	1-3		4	30.07	30.01	0.01
6	29.99	62	60	79	70	62.3	71	ne.	3-0		1	30.04	29.95	0.10
7	29.97	65	62	78	62	60.5	76	nw.-sw.	1-0		1	30.00	29.93	T.
8	29.96	67	64	75	63	61.0	76	nne.	0-3	1-7	1	30.03	29.96	0.00
9	29.87	71	68	78	66	63.5	79	ne.-s.	0	3-0		29.97	29.88	0.00
10	29.89	68	67	79	67	65.5	79	ssw.	1-0	2-5		29.92	29.84	0.00
11	29.96	66	65	79	67	65.7	82	ssw.	1	0	3-7	0	29.96	29.92	T.
12	30.02	63	62	80	65	65.5	82	sw.	1-0		1	30.02	29.95	0.00
13	29.99	72	66.5	80	63	63.3	78	nne.	1-0		2	30.03	29.92	0.00
14	30.04	74	66.5	79	71	63.0	68	ne.	1-0		3	30.06	29.97	T.
15	30.09	73	67	80	72	61.7	64	ne.	1		3	30.11	30.04	0.00
16	30.09	73	67	79	72	63.3	69	ne.	2		4	30.13	30.05	T.
17	30.06	73	65	79	72	62.7	68	ne.	1-3		3	30.12	30.06	0.04
18	30.00	66	64	78	71	62.0	67	ne.	2-0		2	30.08	30.00	T.
19	29.95	65	64	79	66	63.7	79	calm.	0		7-2	30.03	29.93	T.
20	29.98	68	66	78	65	64.7	83	sw.	0		0-7	29.99	29.93	0.07
21	29.99	67	65	80	66	64.3	74	ne.	1-0		4-8	30.02	29.95	T.
22	29.97	69	66	79	67	64.0	78	ne.	1-0		2	30.02	29.91	0.00
23	29.98	64	62	80	66	64.5	78	wsw.	1-0		2	30.00	29.91	0.00
24	30.02	62	61	78	64	63.7	80	sw.	1-0		2	30.04	29.93	0.00
25	30.03	67	66.5	79	62	60.7	74	nne.	0-2		2	30.05	29.96	0.00
26	30.01	66	65	78	67	65.0	82	ne.	1-0		2	30.07	29.96	0.27
27	30.01	65	64	78	65	64.0	81	ne.	1-0		3-6	30.06	29.96	T.
28	30.03	63	62	79	64	64.0	80	ene.	1-0		0-4	30.06	29.96	0.00
29	30.04	68	66	79	63	61.7	77	ene.	2-0		1	30.09	29.99	0.00
30	30.02	69	65	76	68	64.5	80	ne.	1-2	4-7	3	30.08	29.99	0.04
31	30.05	70	67	75	69	63.7	77	ne.	0-2		5	30.09	30.01	0.35
Sums	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1.34
Means	30.000	68.0	64.9	78.4	67.0	63.5	75.9	.....	1.0		2.9	30.040	29.956	.....
Departure.	+.028	.....	.....	.....	.....	+0.5	+2.0	.....	.....		—1.5	.....	.....	—2.58

Mean temperature for the month of December, 1903, (6 + 2 + 9) ÷ 3 = 72.2°; normal is 71.5°. Mean pressure for the month of December, 1903, (9 + 3) ÷ 2 = 29.998; normal is 29.970.

* This pressure is as recorded at 1 p. m., Greenwich time. † These temperatures are observed at 6 a. m., local, or 4:31 p. m., Greenwich time. ‡ These values are the means of (6 + 9 + 2 + 9) ÷ 4. § Beaufort scale.

Maximum thermometer set at 9 p. m. and minimum at 2 p. m., local time.

and the extremely light wind that prevailed, the average force being barely 1.0. This is the lightest of any month on record at the Weather Bureau. As a sequent of the foregoing conditions, the average amount of cloudiness was considerably below the normal.

For the sixth consecutive month the mean pressure was above normal, a condition which has existed eight months out of the twelve. In this connection it is interesting to note

that the average pressure was about as much above the yearly normal as the rainfall was proportionately below. It was remarked in the November summary that the high pressure of the previous months was likely to be followed by a winter of moderate rainfall. The small precipitation of the past month tends to confirm this opinion.

Volcanic activity abated somewhat, that of Mauna Loa's summit crater, Mokuaweoweo, ceasing on the night of the 8th. The disappearance of activity in this crater was as sudden as its beginning; earlier in the evening the reflection was the same as had been common during the eruption, but at about 11 p. m. this suddenly ceased, to be seen no more. Activity of the crater Halemaumau, in Kilauea, was reported at the end of the month to be about the same as at the beginning, a lava lake about 200 feet in diameter having formed in the pit.

A small tidal wave did minor damage at Hookena, Hawaii, during the early morning of the 19th, and the landing at Keawakapu, Maui, was destroyed by high seas at the same time.

Temperature mean for the month, 72.2°; normal, 71.5°; average daily maximum, 78.4°; average daily minimum, 67.0°; mean daily range, 11.4°; greatest daily range, 17° (12th and 24th); least daily range, 5° (4th); highest temperature, 80° (several); lowest temperature, 62° (24th).

Barometer average, 29.998; normal, 29.970; highest, 30.13, 15th; lowest, 29.84, 9th; greatest 24-hour change, that is from any given hour of one day to the same hour on the next, .08; low pressure, 8th to 10th, inclusive; high pressure, 4th to 13th, 17th, and 25th to 31st.

Relative humidity average, 75.9 per cent; normal, 73.9 per cent; mean dew-point, 63.5°; normal, 63.0°; mean absolute moisture, 6.42 grains per cubic foot; normal, 6.32 grains.

Rainfall, 1.34 inches; normal, 3.92 inches; rain record days, 11; normal, 16; greatest rainfall in one day, 0.35 (from 9 a. m. 30th to 9 a. m. 31st); total at Luakaha, 8.81; normal, 10.24; at Kapiolani Park, 0.68; normal, 3.55.

As was the case in November, due principally to the light rainfall, the artesian well water level rose but slightly during the month, from 33.34 to 33.40 feet above mean sea level. This is the lowest December level on record during the five years these observations have been made. The average December rise heretofore has been .44 of a foot. December 31, 1902, it stood at 34.57. The average daily mean sea level for the month was 9.90 feet, the assumed annual mean being 10.00 feet above datum; for December, 1902, it was 9.87.

Trade wind days, 24 (5 nne.); normal, 16; average force of wind during daylight, Beaufort scale, 1.0; average cloudiness, tenths of sky, 2.9; normal, 4.4.

Approximate percentages of district rainfall as compared with normal: Hawaii, Hilo district, 55 per cent; Hamakua, 35; Kohala, 50; Waimea, 13; Kona, 60; Kau, 57; island of Maui, variable from 28 at Wailuku to 119 per cent at Haleakala Ranch; island of Oahu, 40 per cent; island of Kauai, variable from 28 per cent at Waiawa to 175 per cent at Kilauea.

The heaviest monthly rainfall reported was at Olaa Plantation Mill, 10.56 inches. The heaviest 24-hour rainfalls were at Kilauea, Kauai, 4.50 inches on the 1st; Haleakala Ranch, Maui, 2.14 inches on the 8th.

Temperature table for December, 1903.

Stations.	Elevation.	Mean max.	Mean min.	Cor. av'ge.	Highest.	Lowest.
	Feet.	°	°	°	°	°
Hilo	40	78.9	64.2	71.3	83	68
Pepeekeo	100	78.8	66.8	72.1	82	65
Olaa Mill	210	80.6	59.8	69.5	83	58
Kohala	521	76.4	64.8	69.9	81	61
Naalehu	1,903	.....	.....	.....	.....	.....
Waimea	2,730	76.8	56.8	66.1	84	52
Volcano House	4,000	70.9	51.1	60.3	79	48
Waiakoa	2,700	76.5	55.4	65.3	84	52
Keomuku	10	80.6	72.3	75.7	85	68
United States Magnetic Station	50	82.5	64.3	72.7	84	59
W. R. Castle	50	78.0	67.3	71.8	80	61
Ewa Plantation	60	80.7	64.2	71.7	82	58

Kohala, dew-point, 63.8°; relative humidity, 77.6 per cent.

Ewa plantation, dew-point, 61.6°; relative humidity, 69.1 per cent; barometer mean, 29.26.

United States Magnetic Station, dew-point, 63.0; relative humidity, 72.0.

Dew 8 mornings at Honolulu, and lunar halo 30th and 31st.

Reports from other stations: Pepeekeo, Hawaii, snow on mountains 21st, lasting but 2 days; distant thunder and lightning 21st; heavy surf 4–5th, 16th–21st, and 30th–31st; dew 13 mornings; bright morning and afterglow general through the month. Kohala, Hawaii, trade winds 25 days, southwesterly on other days. Waimea, Hawaii, fresh and strong northeast winds, alternating with calms; northerly gale 15th and 16th. Hilo, slight earthquake on the 8th, at 7:15 a. m. Volcano House reports very dry weather.

MEXICAN CLIMATOLOGICAL DATA.

By Señor MANUEL E. PASTRANA, Director of the Central Meteorologic-Magnetic Observatory.

December, 1903.

Stations.	Altitude.	Mean barometer.*	Temperature. Max.	Min.	Mean.	Relative humidity.	Precipitation.	Prevailing direction. Wind.	Cloud.
	Feet.	*Inches.*	° *F.*	° *F.*	° *F.*	%	*Ins.*		
Chihuahua	4,684	25.27	71.6	28.4	46.8	28	0.20	.....	.....
Guadalajara (Obs. del. Est.)	5,186	24.94	75.2	44.6	60.8	61	0.00	nw.	.....
Guanajuato	6,640	23.67	80.6	38.1	60.3	50	0.00	sw.	.....
Leon (Guanajuato)	5,906	24.28	74.7	34.9	56.5	57	T.	nne.	sw.
Mazatlan	25	29.94	81.0	55.0	72.5	72	T.	nw.	.....
Merida	50	29.98	94.3	45.0	71.2	71	0.11	ne.	.....
Mexico (Obs. Cent.)	7,472	23.06	69.8	36.5	53.6	54	T.	ne.	.....
Mexico (E. N. Agric.)	7,442	.....	.....	.....	.....	.....	.....	.....	.....
Monterey (Seminario)	1,626	.....	.....	.....	.....	.....	.....	.....	.....
Morelia (Seminario)	6,401	23.93	73.4	37.4	55.6	58	0.00	sw.	.....
Pachuca	7,959	.....	.....	.....	.....	.....	.....	.....	.....
Parral	.....	24.57	74.5	19.0	49.1	.....	0.04	w.	.....
Puebla (Col. Cath.)	7,108	23.38	74.8	35.6	52.9	68	T.	ne.	.....
Puebla (Col. d Est.)	7,118	23.35	76.1	35.2	52.7	63	0.01	e.	.....
Salina Cruz	492	29.88	87.8	66.2	77.0	61	0.00	ne.	.....
San Juan, Bantista	.....	30.05	81.0	65.7	72.7	82	1.04	ne.	.....
Vera Cruz	.....	30.04	81.7	57.6	81.3	89	0.16	nne.	.....
Zacatecas	8,015	22.49	79.5	21.9	54.0	49	0.00	w.	.....
Zapotlan	5,078	.....	.....	.....	.....	.....	.....	.....	.....

*The monthly barometric means are reduced to the international standard of gravity.

COSTA RICAN CLIMATOLOGICAL DATA.

Communicated by Mr. H. PITTIER, Director, Physico-Geographic Institute.

TABLE 1.—*Hourly observations at the Observatory, San José de Costa Rica, during December, 1903.*

Hours.	Pressure.		Temperature.		Relative humidity.		Rainfall.		
	Observed, 1903.	Normal, 1889–1900.	Observed, 1903.	Normal, 1889–1900.	Observed, 1903.	Normal, 1889–1900.	Observed, 1903.	Normal, 1889–1900.	Duration, 1903.
	Inches.	*Inches.*	° *F.*	° *F.*	%	%	*Ins.*	*Ins.*	*Hrs.*
1 a. m	26.12	26.14	61.7	61.8	90	87	0.47	0.02	7.00
2 a. m	26.13	26.12	61.6	61.5	89	87	0.46	0.08	8.00
3 a. m	26.12	26.11	61.5	61.3	89	87	0.15	0.02	6.50
4 a. m	26.11	26.10	61.5	61.1	89	87	0.09	0.02	4.67
5 a. m	26.11	26.11	61.3	60.9	89	87	0.19	0.06	3.84
6 a. m	26.12	26.12	61.0	60.9	89	87	0.30	0.05	3.83
7 a. m	26.13	26.14	61.3	61.3	88	86	.....	0.04	.....
8 a. m	26.14	26.15	63.4	64.0	82	81	0.01	0.04	0.50
9 a. m	26.16	26.17	66.0	66.6	77	76	0.10	0.02	2.01
10 a. m	26.17	26.17	68.5	70.0	74	71	0.20	0.02	4.50
11 a. m	26.16	26.16	69.4	71.9	72	68	0.13	0.07	3.17
Noon	26.15	26.15	70.1	73.1	72	67	0.22	0.08	3.67
1 p. m	26.13	26.12	70.4	73.8	73	67	0.15	0.08	2.84
2 p. m	26.11	26.10	70.6	73.7	72	67	0.12	0.11	2.67
3 p. m	26.09	26.09	70.2	72.9	72	69	0.16	0.09	3.50
4 p. m	26.08	26.08	69.2	71.2	75	70	0.18	0.22	5.00
5 p. m	26.08	26.09	67.4	69.0	78	76	0.23	0.12	4.00
6 p. m	26.09	26.10	65.3	66.6	81	78	0.34	0.08	4.50
7 p. m	26.11	26.12	64.1	65.0	85	83	0.19	0.09	4.33
8 p. m	26.13	26.13	63.3	64.2	87	83	0.23	0.04	4.83
9 p. m	26.14	26.15	62.9	63.7	87	85	0.56	0.05	7.01
10 p. m	26.16	26.16	62.6	63.1	88	85	0.22	0.05	8.16
11 p. m	26.16	26.16	62.2	62.5	89	86	0.28	0.07	7.50
Midnight	26.15	26.15	59.8	62.2	89	86	0.26	0.03	5.17
Mean	26.13	26.13	64.8	65.9	82	79	.....	.....	.....
Minimum	26.03	25.95	57.4	48.6	33	.....	.....	.....	.....
Maximum	26.22	26.29	82.9	84.6	100	.....	.....	.....	.....
Total	.....	.....	.....	.....	.....	.....	5.24	1.55	107.20

REMARKS.—At San José the barometer is 1169 meters above sea level. Readings are corrected for gravity, temperature, and instrumental error. The hourly readings for pressure, and wet and dry bulb thermometers, are obtained by means of Richard registering instruments, checked by direct observations every three hours from 7 a. m. to 10 p. m. The thermometers are 1.5 meters above ground and are corrected for instrumental errors. The total hourly rainfall is as given by Hottinger's self-register, checked once a day. Under maximum, the greatest hourly rainfall for the month is given. The standard rain gage is 1.5 meters above ground. Since January 1, 1902, observations at San José have been made on seventy-fifth meridian time, which is 0 hours, 36 minutes, 13.3 seconds *in advance* of San José local time. The normals for pressure, temperature, and relative humidity have been adjusted to this time; the normal for rainfall in Table 1 and the sunshine observations and normal in Table 2 refer to local time. At Port Limon the hours of direct observation are 8 a. m., 2 and 8 p. m., San José local time; the barometer is 3.4 meters above sea level. The means for temperature and relative humidity in Table 4 are obtained from two-hourly readings given by a Richard self-registering thermometer.

TABLE 2.—*San José, December, 1903.*

Time.	Sunshine.		Cloudiness.		Temperature of the soil at depth of—				
	Observed, 1903.	Normal, 1889–1900.	Observed, 1903.	Normal, 1889–1900.	6 inches.	12 inches.	24 inches.	48 inches.	120 inches.
	Hours.	*Hours.*	%	%	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*
7 a. m	1.51	4.89	67	47	66.8	67.4	68.8	69.5	70.1
8 a. m	12.46	17.86	.....	.....	.....	.....	.....	.....	.....
9 a. m	12.62	18.54	.....	.....	.....	.....	.....	.....	.....
10 a. m	10.95	17.43	83	55	66.9	67.7	68.8	69.6	.....
11 a. m	11.33	15.40	.....	.....	.....	.....	.....	.....	.....
Noon	8.43	13.98	.....	.....	.....	.....	.....	.....	.....
1 p. m	7.28	14.17	83	60	67.5	67.5	68.8	69.6	.....
2 p. m	9.89	14.95	.....	.....	.....	.....	.....	.....	.....
3 p. m	8.35	14.82	.....	.....	.....	.....	.....	.....	.....
4 p. m	9.71	14.08	85	63	67.9	67.7	68.8	69.6	.....
5 p. m	7.02	9.85	.....	.....	.....	.....	.....	.....	.....
6 p. m	1.58	1.77	.....	.....	.....	.....	.....	.....	.....
7 p. m	.....	.....	79	55	67.9	67.8	68.9	69.5	.....
8 p. m	.....	.....	.....	.....	.....	.....	.....	.....	.....
9 p. m	.....	.....	.....	.....	.....	.....	.....	.....	.....
10 p. m	.....	.....	63	48	67.6	67.7	68.9	69.5	.....
11 p. m	.....	.....	.....	.....	.....	.....	.....	.....	.....
Midnight	.....	.....	.....	.....	.....	.....	.....	.....	.....
Mean	.....	.....	77	55	67.5	67.6	68.8	69.5	70.1
Total	101.13	157.74	.....	.....	.....	.....	.....	.....	.....

TABLE 3.—*Rainfall at stations in Costa Rica, December, 1903.*

Stations.	Height above sea level.	Observed, 1903.		Averages.		
		Amount.	Number of days.	Number of years.	Amount.	Number of days.
	Feet.	*Inches.*			*Inches.*	
Sipurio (Talamanca)	60	41.50	24	3	13.11	15
Boca Banano	3	33.66	26	7	12.95	20
Port Limon	3	.....	.....	9	16.65	18
Swamp Mouth	3	.....	.....	5	16.14	13
Zent	20	45.24	30	2	15.39	17
Siquirres	60	.....	.....	5	12.13	9
Dos Novillos	122	60.51	27	.....	.....	.....
Guapiles	300	.....	.....	3	14.61	17
Cariblanco (Sarapiquí)	835	.....	.....	5	17.83	21
San Carlos	161	41.42	29	5	9.37	18
Las Lomas	266	.....	.....	3	15.59	15
Peralta	332	49.45	26	5	9.21	17
Turrialba	620	8.32	20	8	15.79	18
Juan Viñas	1,040	.....	.....	7	10.47	11
Santiago	1,100	.....	.....	2	6.85	14
Paraiso	1,336	.....	.....	2	3.35	10
Cachi	1,020	20.43	25	2	2.68	18
Las Concavas	1,337	12.48	29	2	1.81	16
Cartago	1,451	.....	.....	2	3.70	22
Tres Rios	1,300	4.36	18	14	1.93	6
San Francisco Guadalupe	1,187	.....	.....	7	1.26	6
San José	1,160	5.24	21	14	1.55	6
La Verbena	1,140	5.04	21	7	2.20	6
Nuestro Amo	791	2.72	8	7	0.63	10
Alajuela	950	.....	.....	3	1.46	3
San Isidro Alajuela	1,346	4.80	20	2	2.01	4
Las Cañas	780	1.93	21	.....	.....	.....

TABLE 4.—*Observations taken at Port Limon and Zent, December, 1903.*

Stations.	Pressure.			Temperature.			Relative humidity.
	Minimum.	Maximum.	Mean.	Minimum.	Maximum.	Mean.	
	Inches.	*Inches.*	*Inches.*	° *F.*	° *F.*	° *F.*	%
Port Limon	.....	.....	.....	.....	.....	.....	.....
Zent	.....	.....	.....	65.1	87.6	74.1	90

Stations.	Cloudiness.	Sunshine.	Rainfall.		Temperature of soil at depth of—		
			Amount.	Number of days.	6 inches.	12 inches.	24 inches.
	%	*Hours.*	*Inches.*		° *F.*	° *F.*	° *F.*
Port Limon	.....	.....	.....	.....	.....	.....	.....
Zent	82	83.78	45.24	30	76.1	76.2	76.6

Chart I. Tracks of Centers of High Areas. December, 1903.

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Chart I. Tracks of Centers of High Areas. December, 1903.

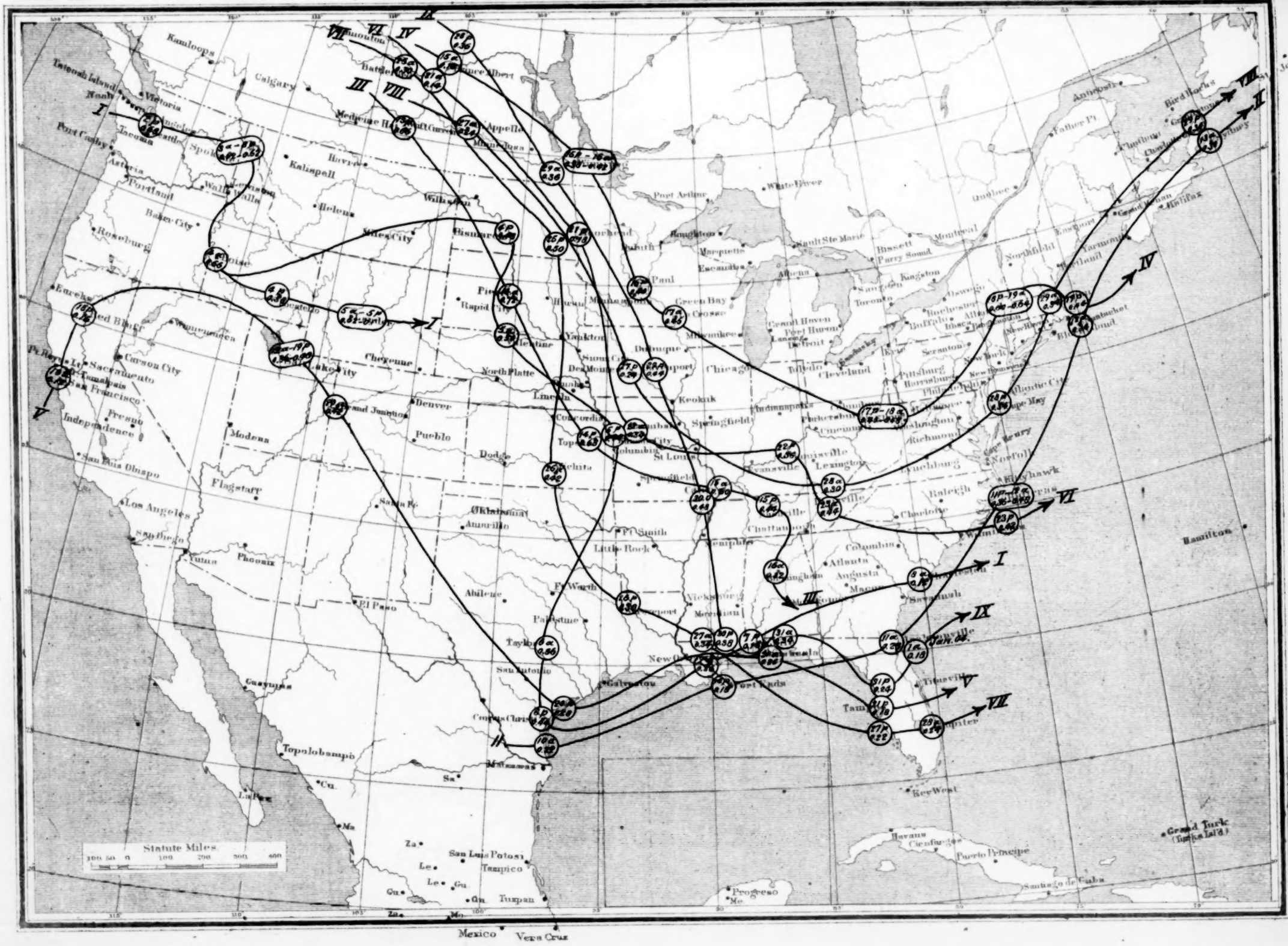

Chart II. Tracks of Centers of Low Areas. December, 1903.

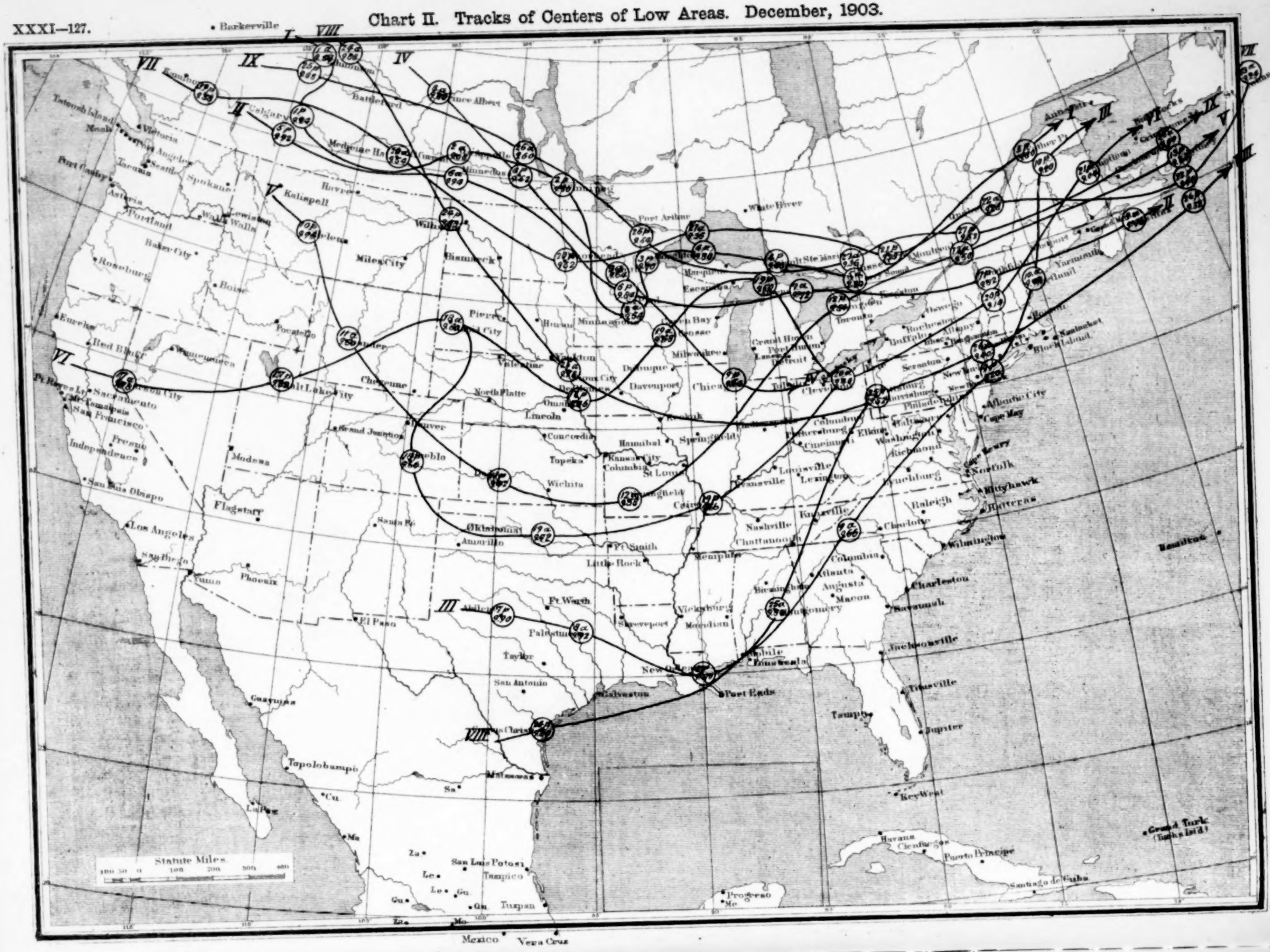

Chart III. Total Precipitation. December, 1903.

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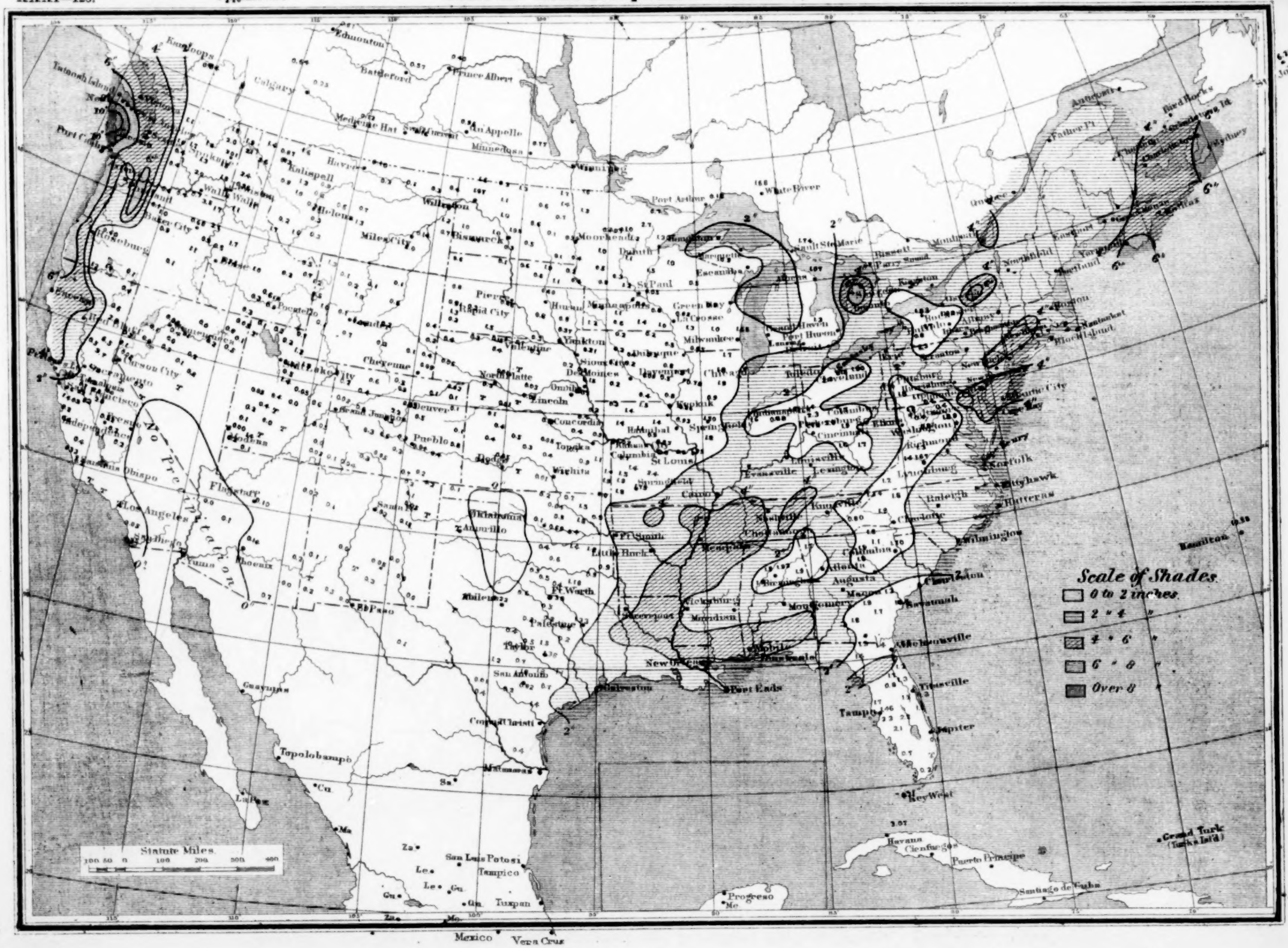


Chart IV. Sea-Level Pressure and Temperature; Resultant Surface Winds. December, 1903.

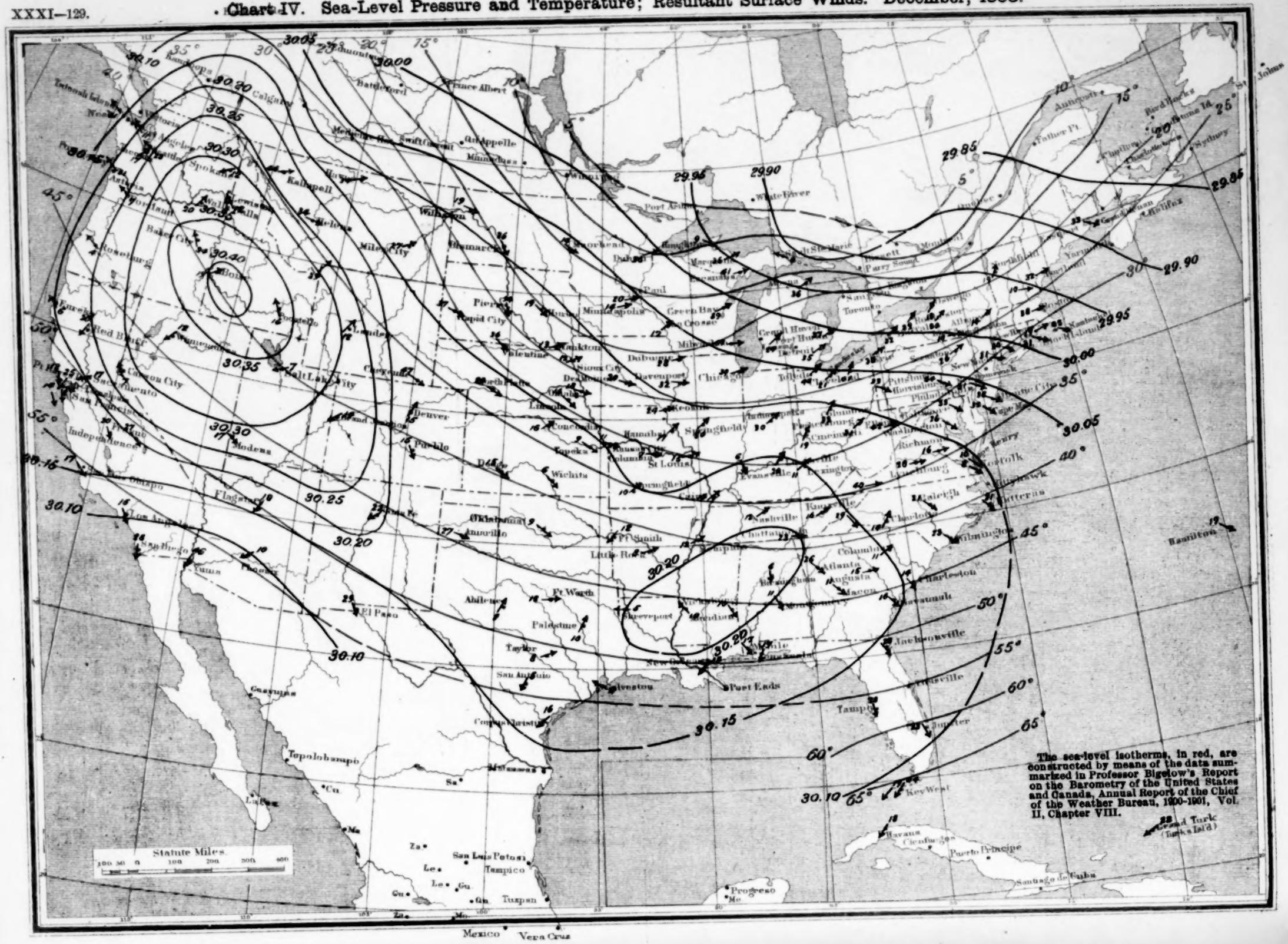
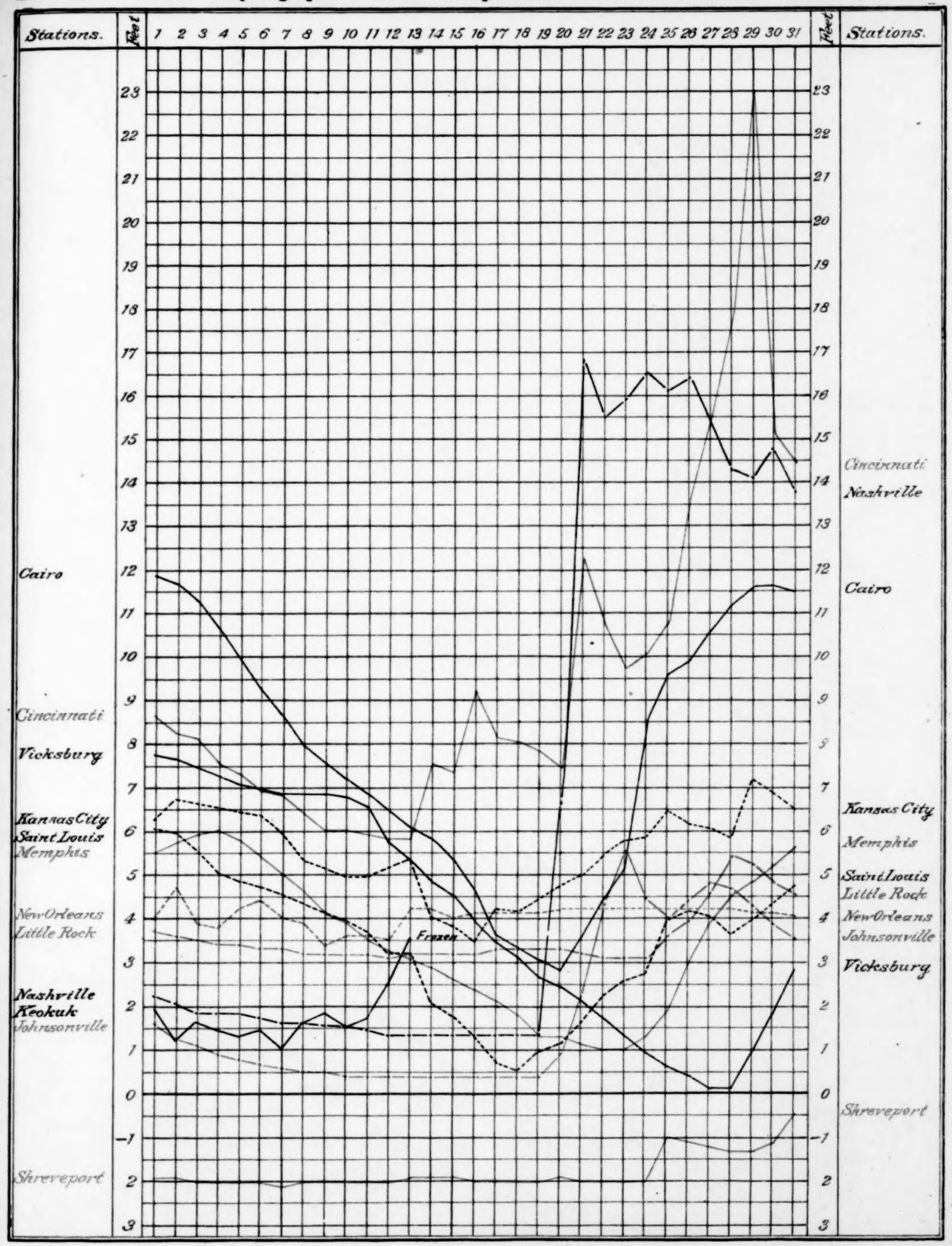
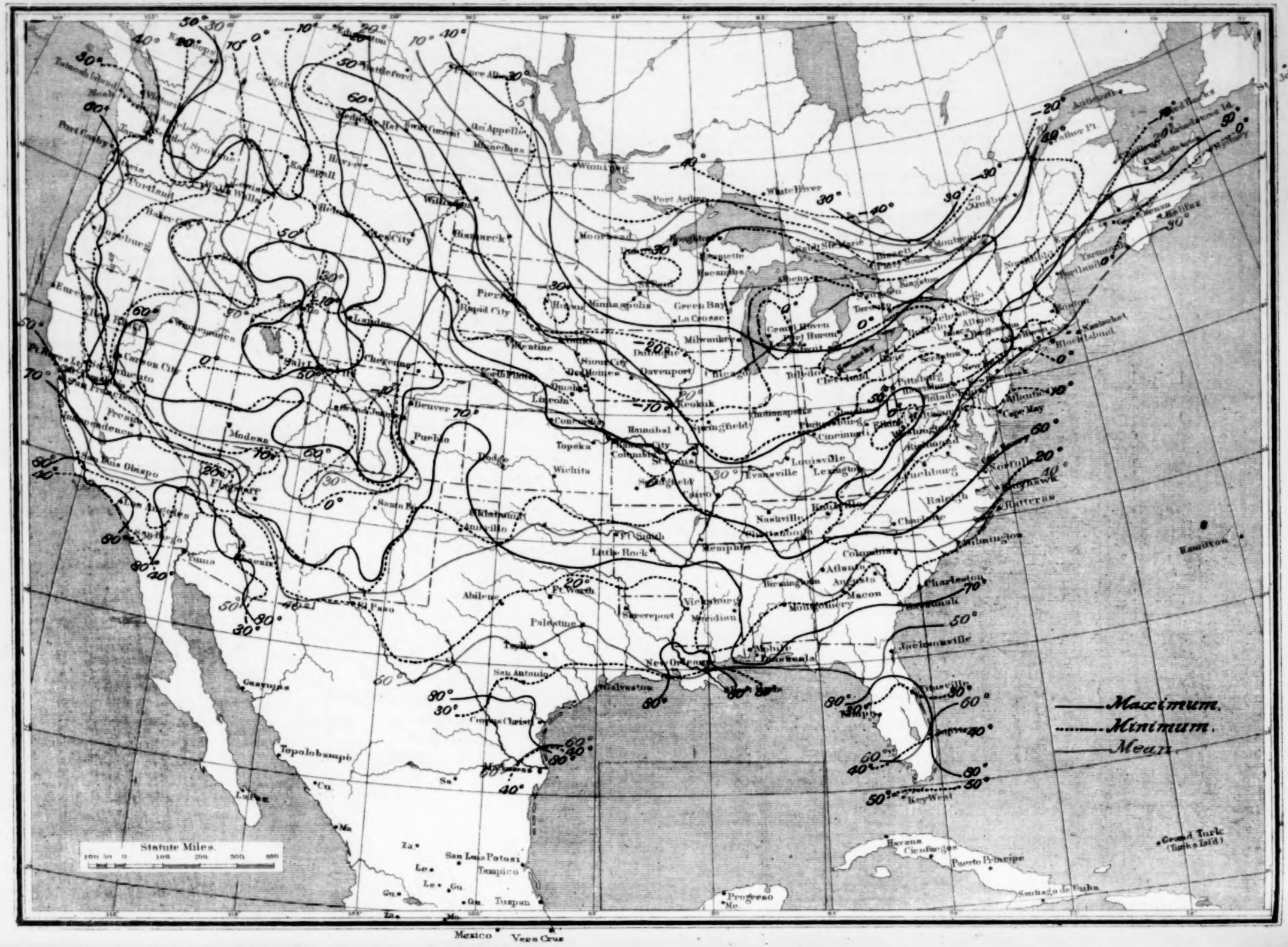

The sea-level isotherms, in red, are constructed by means of the data summarized in Professor Bigelow's Report on the Barometry of the United States and Canada, Annual Report of the Chief of the Weather Bureau, 1900-1901, Vol. II, Chapter VIII.
Statute Miles
Mexico
Vera Cruz

Chart V. Hydrographs for Seven Principal Rivers of the United States. December, 1903.



• Barkerville **Chart VI. Surface Temperatures; Maximum, Minimum, and Mean. December, 1903.**



• Barkerville **Chart VII. Percentage of Sunshine. December, 1903.**

Chart VII. Percentage of Sunshine. December, 1903.

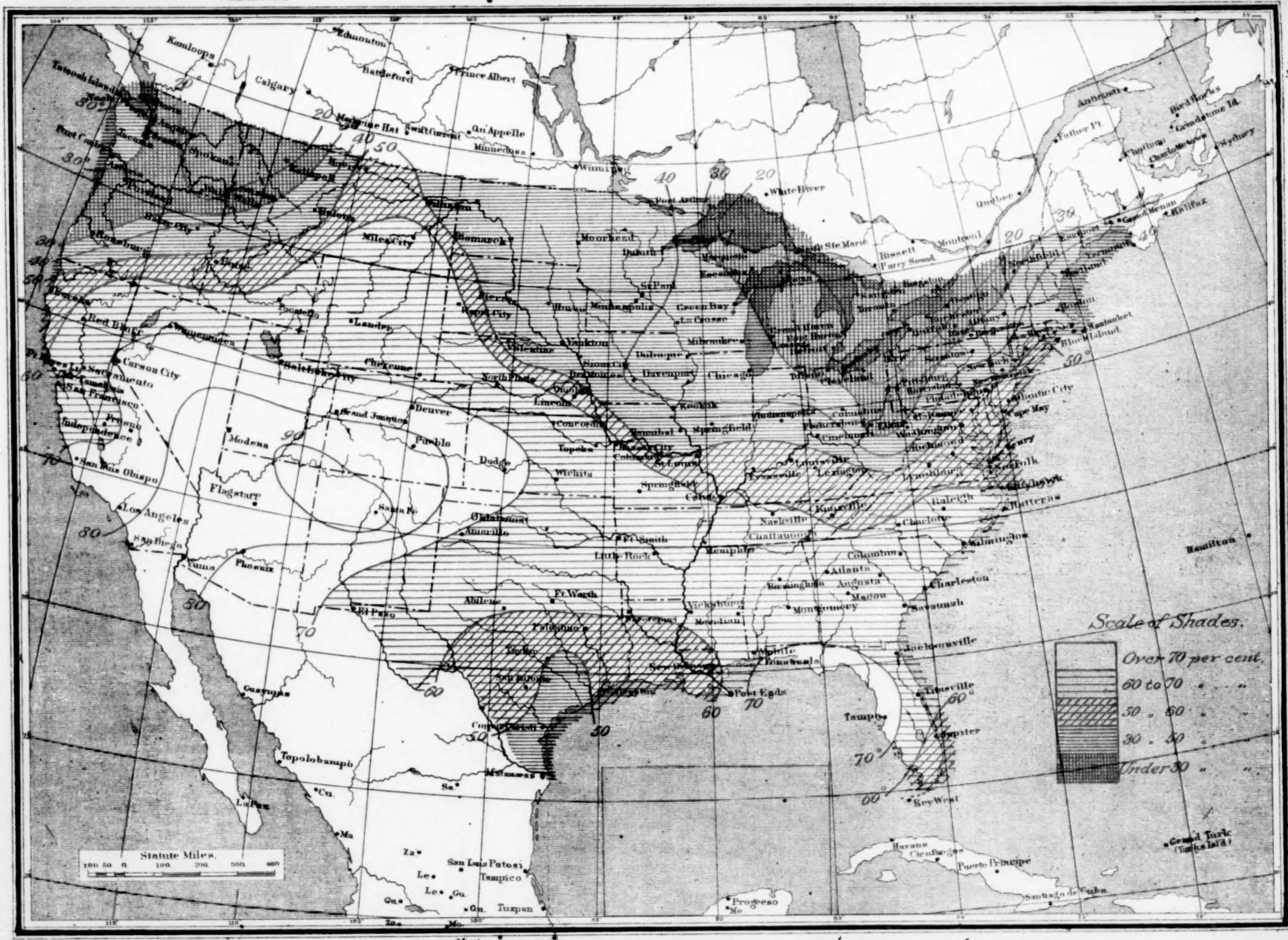


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Chart VIII. Isobars and Isotherms at 10,000 feet. December, 1903.

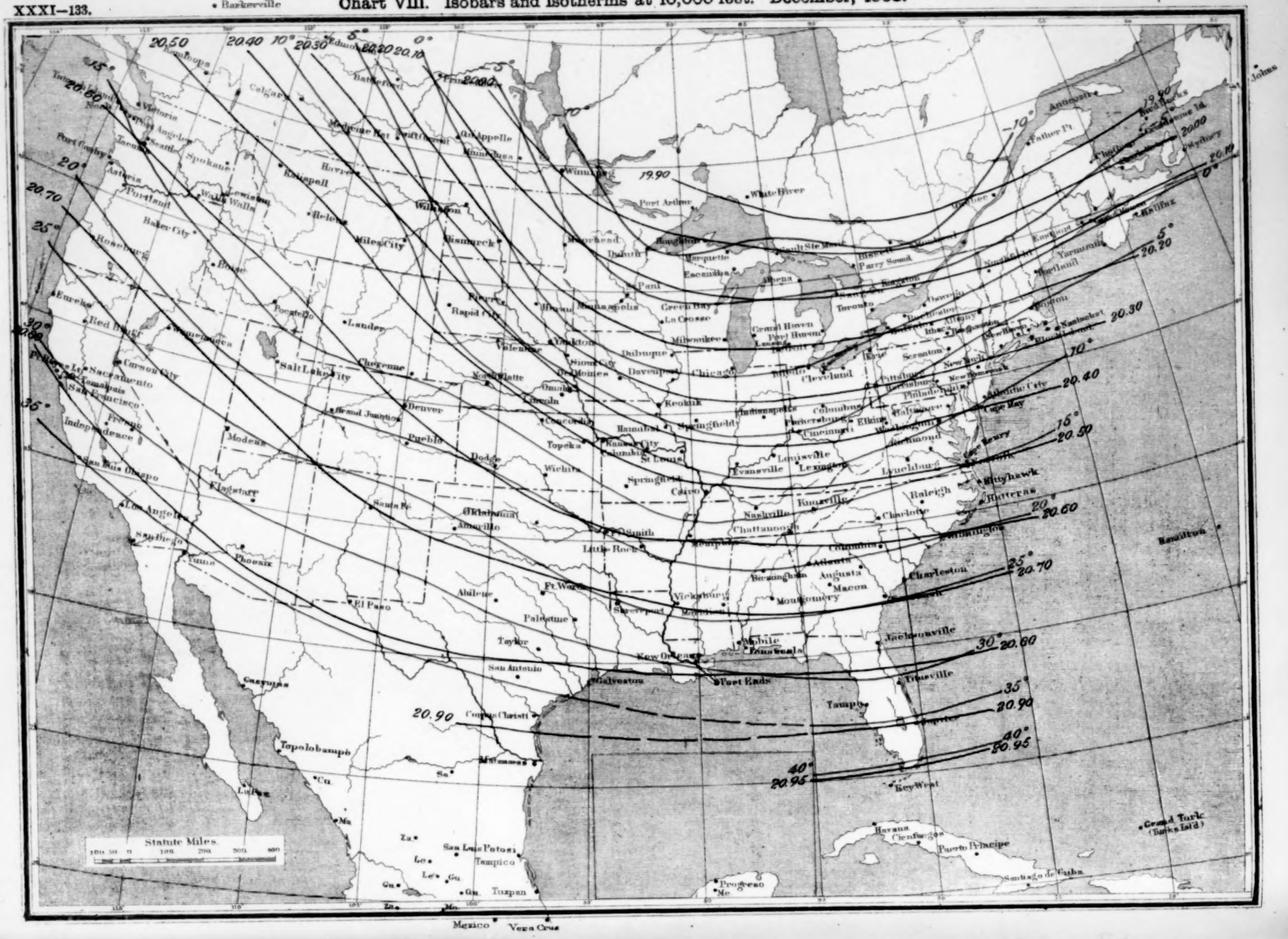

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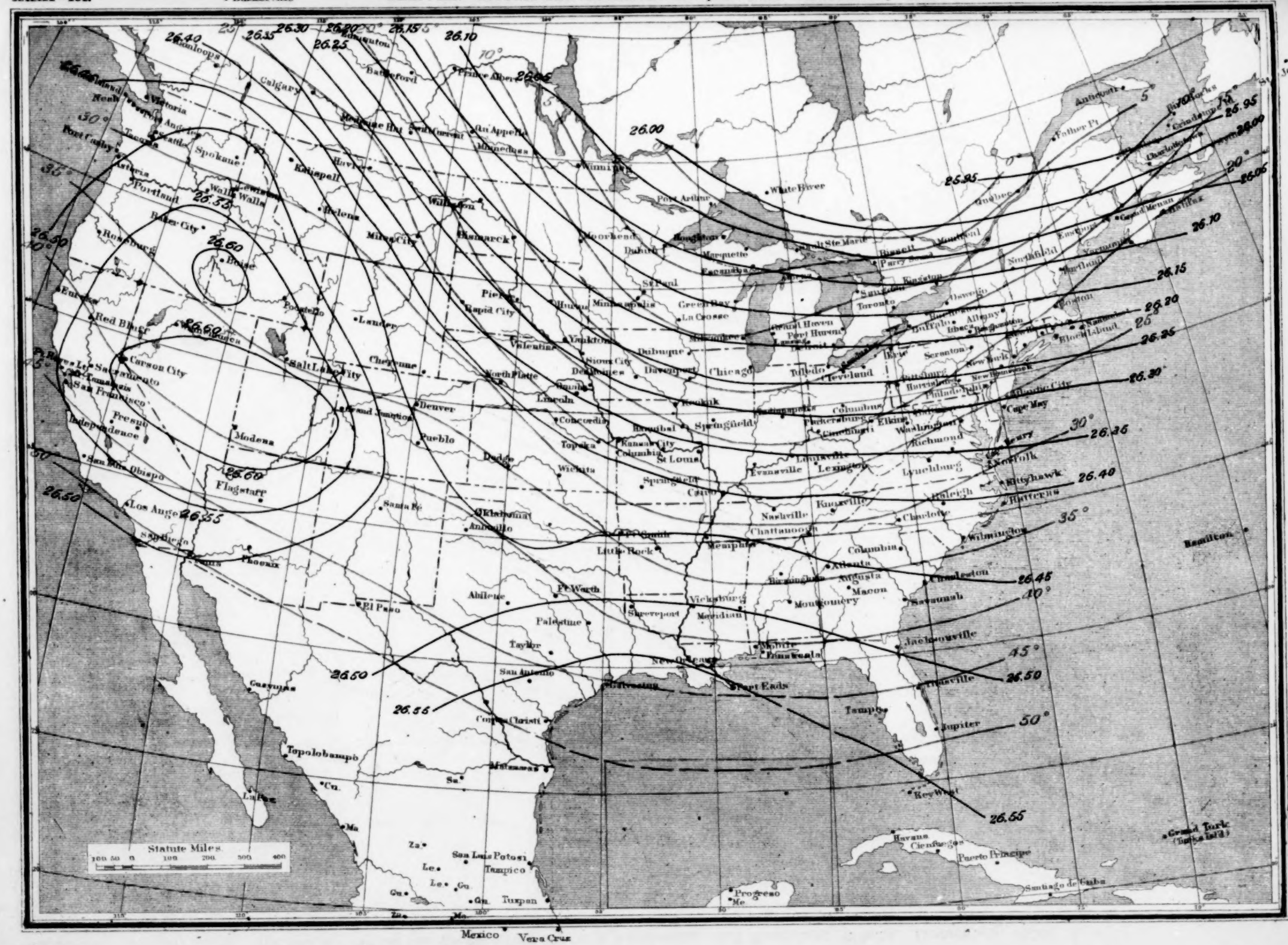
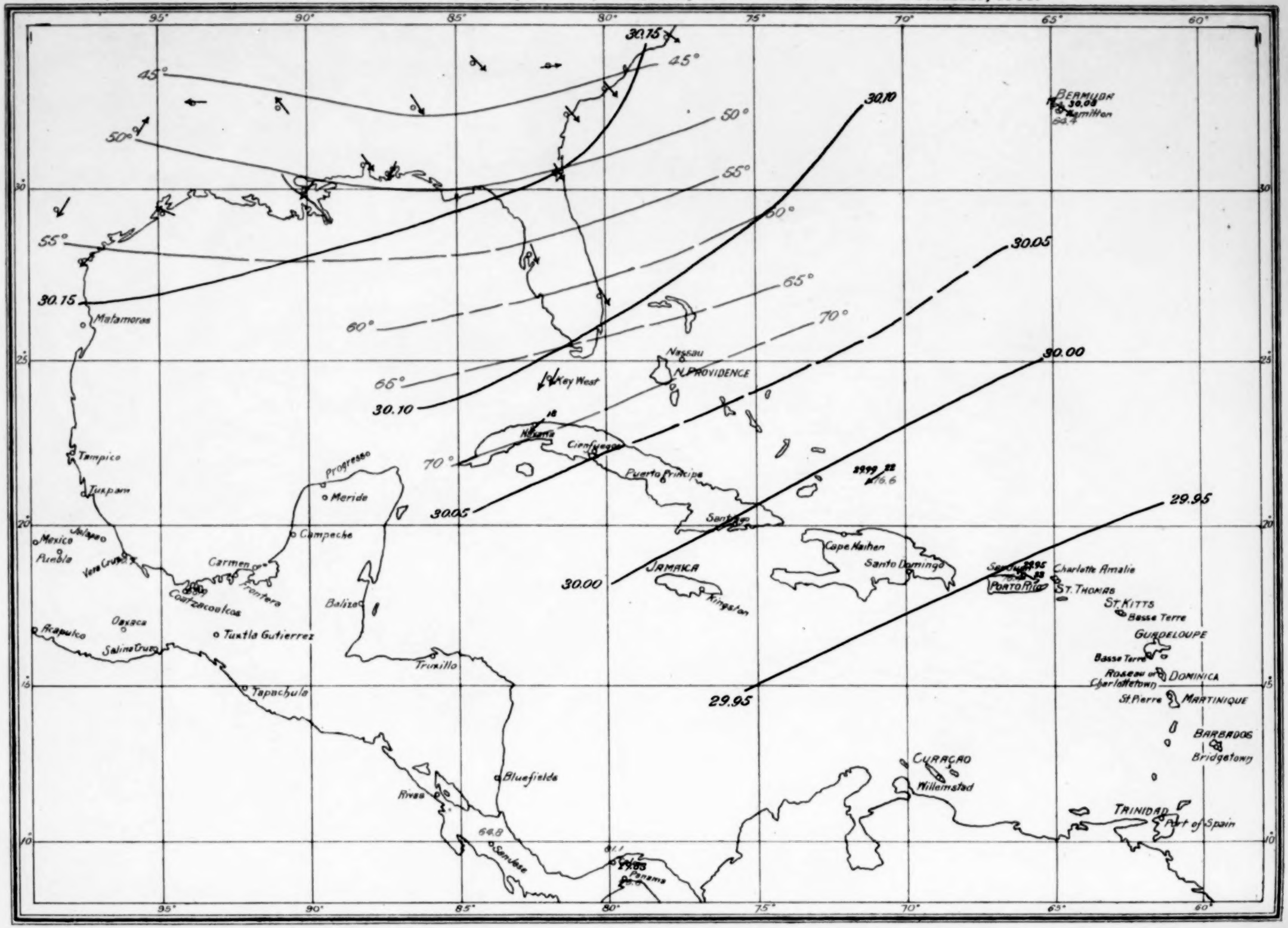
Chart IX. Isobars and Isotherms at 3,500 feet. December, 1903.

Chart IX. Isobars and Isotherms at 3,500 feet. December, 1903.



XXXI—135.

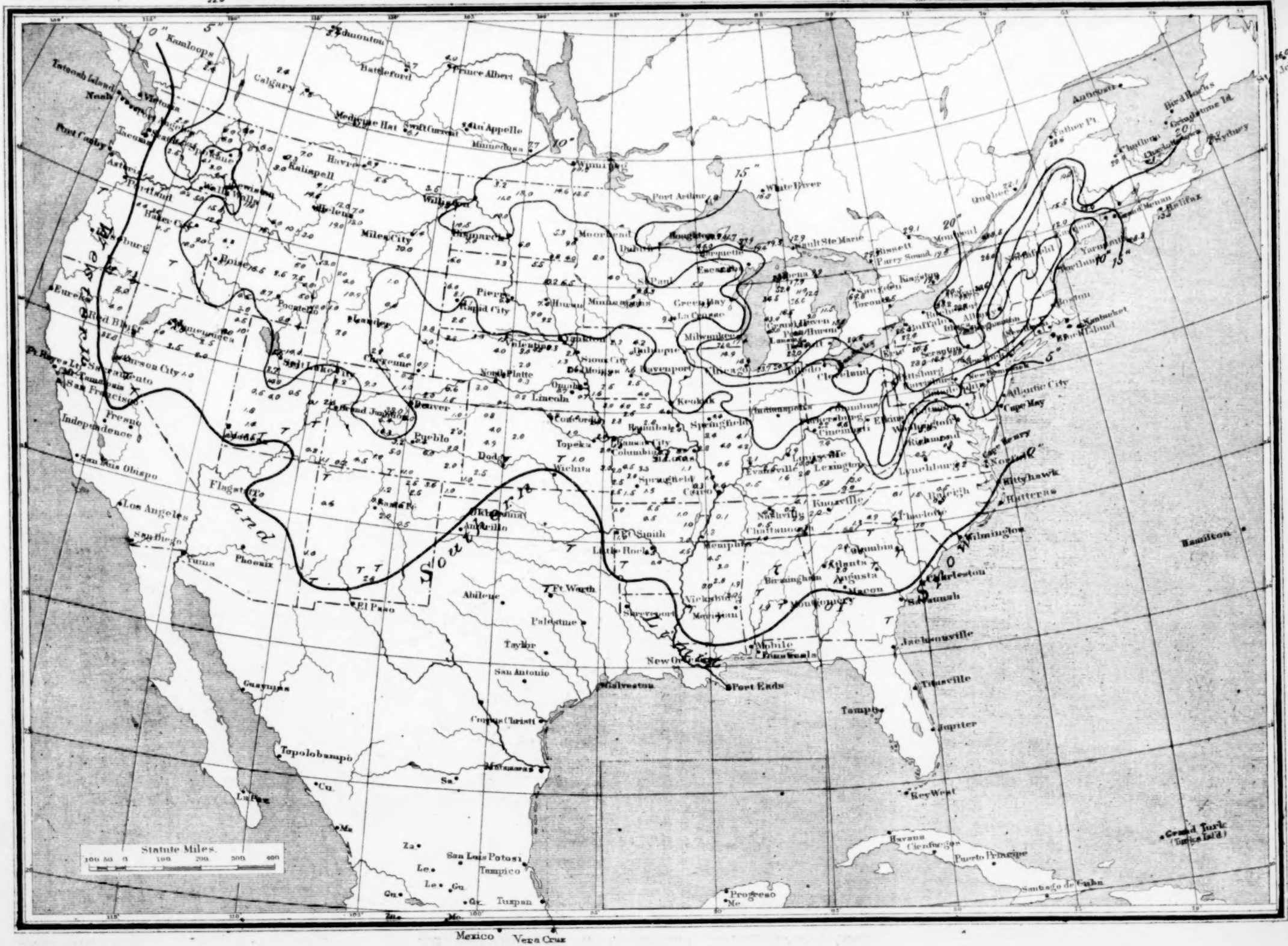
Chart X. West Indian Monthly Isobars, Isotherms, and Resultant Winds. December, 1903.



XXXI—136.

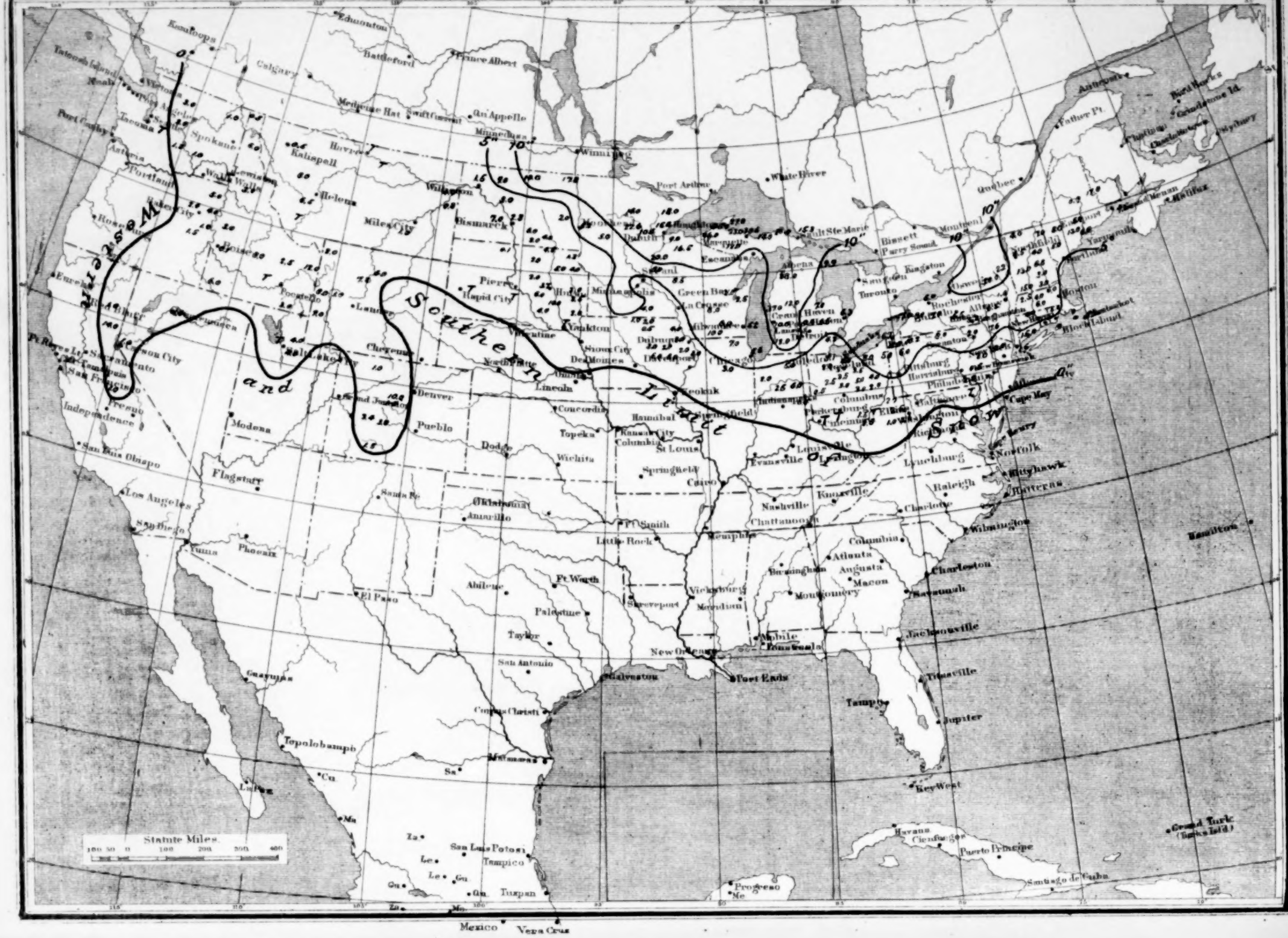
Chart XI. Total Snowfall for December, 1903.

Chart XI. Total Snowfall for December, 1903.



• Baskerville

XII. Depth of Snow on Ground, December 31, 1903.


Edmonton
Battleford
Prince Albert
Calgary
Medicine Hat
Swift Current
Qu'Appelle
Minnedosa
Winnipeg
Kamloops
Victoria Island
Nanaimo
Spokane
Kalispell
Havre
Portland
Walla Walla
Helena
Miles City
Bismarck
Port Arthur
White River
Sault Ste Marie
Duluth
Escanaba
Quebec
Montreal
Father Pt.
Bird Rocks
Cheticamp
Sydney
Pictou
Halifax
Bissett
Parry Sound
Kingston
Toronto
Rochester
Buffalo
Oswego
Utica
Albany
Boston
Worcester
Yarmouth
Pierre
Rapid City
Green Bay
La Crosse
Milwaukee
Chicago
Detroit
Cleveland
Pittsburg
Harrisburg
Philadelphia
Cape May
Atlantic City
Baltimore
Washington
Norfolk
Hatteras
Wilmington
Charleston
Savannah
Jacksonville
Tallahassee
Tampa
Jupiter
Key West
Havana
Cienfuegos
Puerto Principe
Santiago de Cuba
Grand Turk (Turks Isld.)
Hamilton
Yellowstone
Boise
Rosebud
Emeryville
Reno
Carson City
Sacramento
San Francisco
Fresno
Independence
San Luis Obispo
Los Angeles
San Diego
Yuma
Phoenix
Flagstaff
Santa Fe
Oklahoma
Amarillo
El Paso
Abilene
Ft Worth
Palestine
Taylor
San Antonio
Galveston
Port Eads
New Orleans
Mobile
Pensacola
Vicksburg
Shreveport
Meridian
Montgomery
Birmingham
Atlanta
Augusta
Macon
Columbia
Charlotte
Raleigh
Knoxville
Nashville
Chattanooga
Memphis
Little Rock
Ft Smith
Louisville
Evansville
Cairo
Springfield
Indianapolis
Columbus
Cincinnati
Lynchburg
Richmond
Petersburg
Elkins
Wheeling
Toledo
Detroit
Cleveland
Buffalo
Rochester
Syracuse
Oswego
Utica
Albany
Boston
Worcester
Yarmouth
Montreal
Kingston
Toronto
Bissett
Parry Sound
Sault Ste Marie
Port Arthur
White River
Winnipeg
Duluth
Escanaba
Green Bay
La Crosse
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Louisville
Cincinnati
Columbus
Toledo
Detroit
Cleveland
Pittsburg
Harrisburg
Philadelphia
Cape May
Atlantic City
Baltimore
Washington
Norfolk
Hatteras
Wilmington
Charleston
Savannah
Jacksonville
Tallahassee
Tampa
Jupiter
Key West
Havana
Cienfuegos
Puerto Principe
Santiago de Cuba
Grand Turk (Turks Isld.)
Hamilton
Bermuda
Progreso
Merida
Tampico
San Luis Potosi
Monterey
Matamoras
Laredo
Corpus Christi
Brownsville
Guaymas
Topolobampo
La Paz
Mazatlan
Zacatecas
Guadalajara
Colima
Acapulco
Oaxaca
Tuxpan
Vera Cruz
Mexico
Statute Miles
100 50 0 100 200 300 400
5"
10"
10"
10